

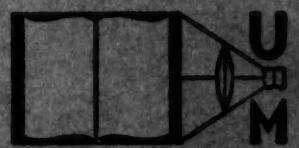
Vol. XII

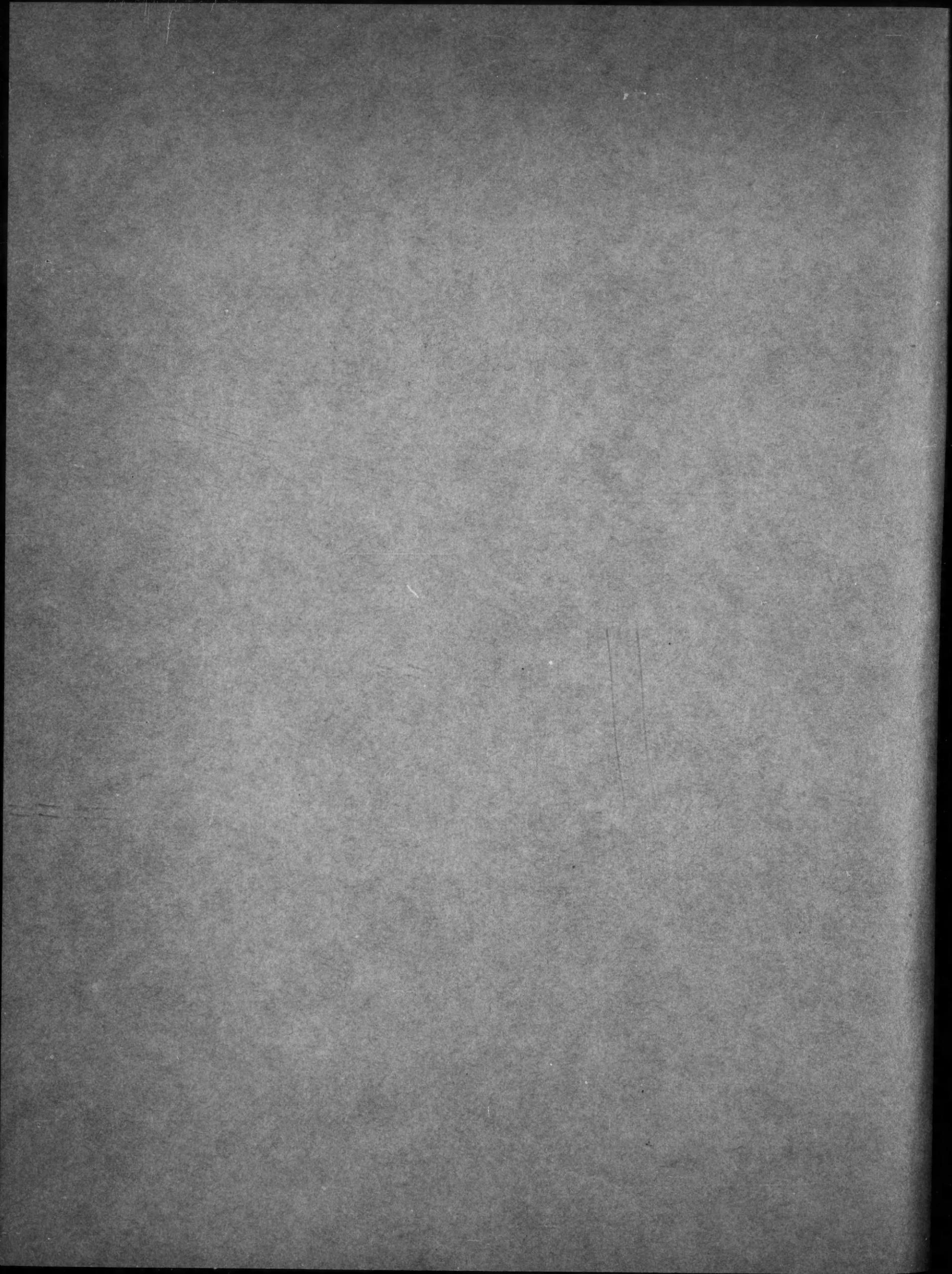
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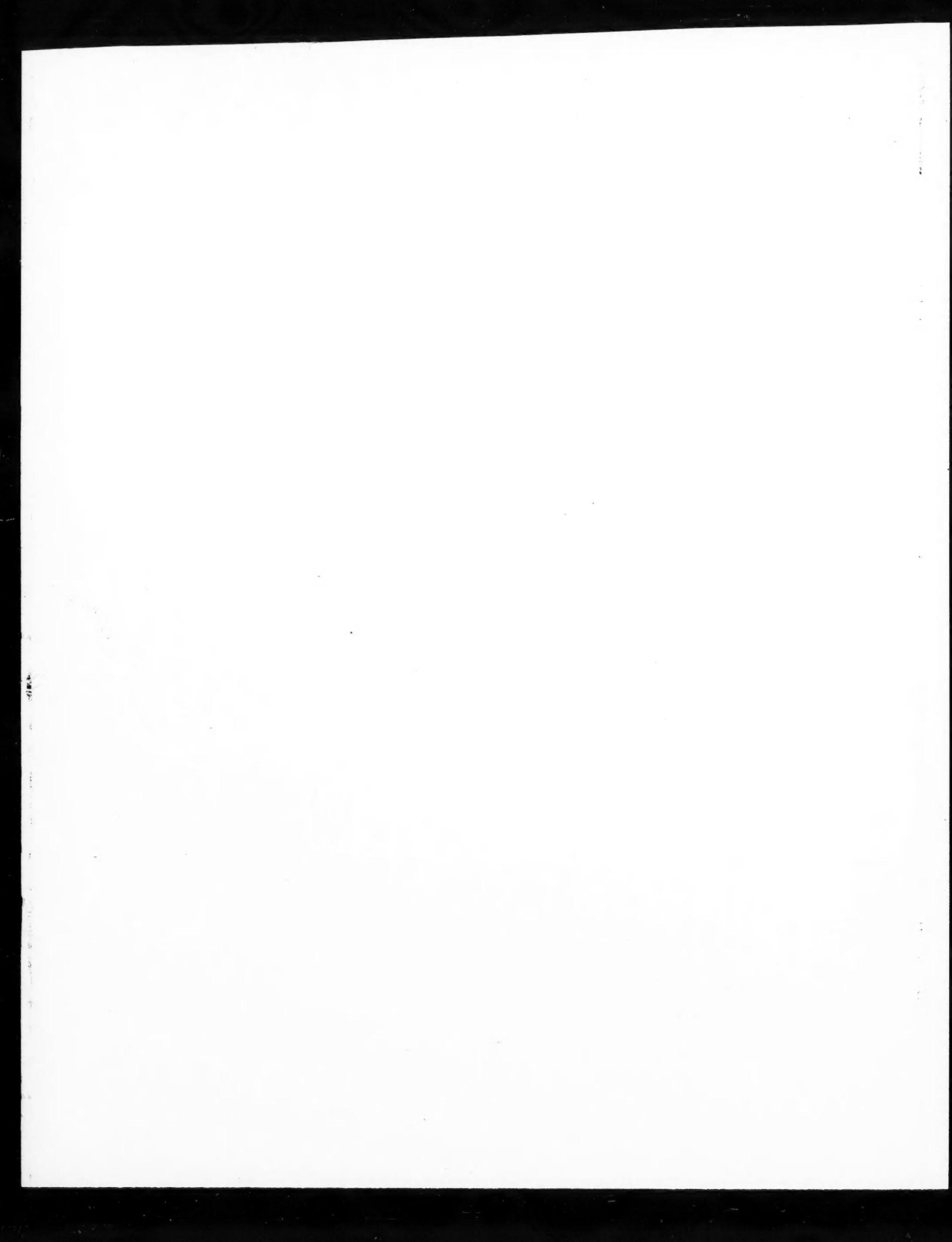
DISSERTATION  
ABSTRACTS  
(formerly MICROFILM ABSTRACTS)

*A GUIDE TO DISSERTATIONS AND  
MONOGRAPHS AVAILABLE IN MICROFORM*

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Vol. XII

No. 2

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*A GUIDE TO DISSERTATIONS AND  
MONOGRAPHS AVAILABLE IN MICROFORM*

UNIVERSITY MICROFILMS  
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## INTRODUCTION

With a view toward a more accurate and descriptive title, the name MICROFILM ABSTRACTS has been changed to DISSERTATION ABSTRACTS. The format has been changed from 5 1/2 x 8 1/2 inches to 8 1/2 x 11 inches, since with this larger size less shelf space will be required in libraries. There will be six issues per year, one containing cumulative author and subject indexes for the year. The free distribution to selected libraries has been discontinued in favor of a straight subscription basis.

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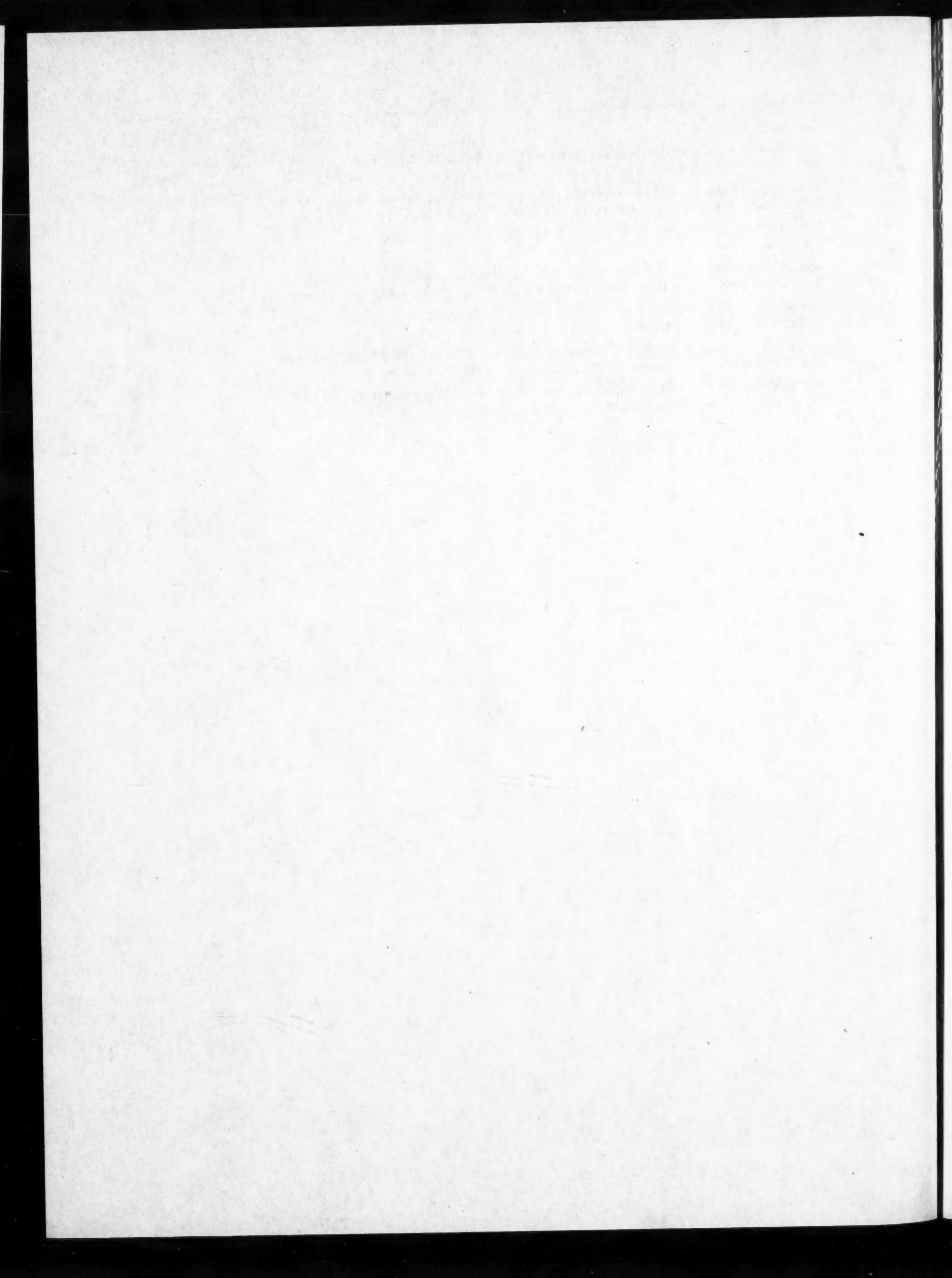
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**PART II**

**MONOGRAPHS**



## AGRONOMY

### INHERITANCE OF CHARACTERS IN CORN WITH SPECIAL REFERENCE TO THE EUROPEAN CORN BORER

(Publication No. 3086)

Attie Anderson Fleming, Ph.D.  
University of Minnesota, 1951

The primary objective of this study was to determine the mode of inheritance of reaction to first brood infestation of the European corn borer and the relation of that reaction to certain agronomic characters in maize. The secondary objective was to determine the mode of inheritance of rind-hardness, maturity and tillering.

For the investigation two inbred lines, A357 and F1 235, their F<sub>1</sub>, F<sub>2</sub> and two backcross progenies were planted in nine complete randomized blocks at one location. The high-combining Minnesota inbred line, A357, was characterized by a susceptible reaction to the European corn borer, weak rind, early maturity and non-tillering habit. The F1 235 had moderate resistance and tolerance to the borer, hard rind, late maturity, and usually four or five tillers.

An estimated total of 125 corn borer eggs was applied on five different dates to each plant. Individual plants were classified under these conditions of manual infestation into various classes for leaf feeding, overall damage, rind-hardness, maturity, tillering, stalk breakage, and flinty and floury endosperm.

In general the analyses of the data for the inheritance studies followed the methods of Powers (1) and Mather (2). For strict validity of these methods a scale must be used which shows that the genic effect is additive. Considerable difficulty was encountered for some of the characters in finding a scale which would satisfy the requirements in all the segregating progenies. In some cases where neither the arithmetic nor logarithmic scale conformed to the standards, the one which fit best in expressing additivity was used. Conclusions were based on one year's data.

Striking differences in the within variances of the non-segregating progenies presented a problem in some cases when determining the environmental variances. Consequently, modifications of Powers' method of calculating the environmental variances were used.

The genes for the characters: resistance to leaf feeding, resistance to overall damage, hard rind, and tillering, showed partial phenotypic dominance in the F<sub>1</sub>. Genes for maturity showed an intermediate reaction.

The data indicated that relatively few major genes control resistance both to leaf feeding and to overall damage by the first brood of borers. For overall damage the heterozygous F<sub>1</sub> had more resistance than the genotypes which were partially homozygous for resistance. Segregation for overall damage

was explained on the basis of two pairs of major genes or their equivalents with differential interallelic and intraallelic actions occurring for different genotypes. Data on leaf feeding also indicated two pairs of major genes were differentiating the parents. Similar estimates of heritability, .2504 and .2315, were obtained for leaf feeding and overall damage. They provide information as to the effectiveness of individual plant selection for these characters.

Classification of overall damage was based on the extent of leaf feeding, and damage to midribs, internodes and tassel. Regression of overall damage on leaf feeding and the simple correlation coefficient between the two characters were highly significant. The F<sub>2</sub> data suggested that approximately 25 per cent of the variation in overall damage was due to differences in leaf feeding. Selection for resistance or tolerance to the first brood infestation of the European corn borer does not appear to be an extremely difficult task under conditions of manual infestation. The backcross method may be advantageous for adding resistance to otherwise desirable lines.

A highly significant chi-square and correlation coefficient showed an association between overall damage and maturity in the F<sub>2</sub>. However, the low value of  $r$ , .23, indicated that adjustment of ratings for overall damage was not necessary although the earlier plants had a tendency to be more susceptible. There was no association between overall damage by the first brood and the characters, rind-hardness and tillering.

A field method of measuring the hardness of the rind with two puncture-test instruments was used. This method may have some value for selecting plants with a hard rind. Only one of the instruments was utilized in the inheritance study. Definite differences in rind-hardness were observed between plants. There was a negative association between hardness of the rind and stalk breakage below the ear. It appears there are at least three pairs of major genes and probably four pairs controlling rind-hardness in this cross of A357 X F1 235.

The F1 235 line was approximately 18 days later in shedding pollen than A357. Data suggested that a minimum of four factor pairs and probably more were differentiating the parents for maturity. Late maturing plants tended to have a harder rind than the early maturing plants. This association may be genetic or physiologic.

For some unknown reason an extremely high variation for tillering was obtained in the backcross to A357, the non-tillering parent. A rough estimate of the number of factors controlling tillering was obtained from the frequency distributions. The F<sub>2</sub> and backcross progenies appeared to fit a two-factor-pair hypothesis better than for one or three factor pairs. The early maturing plants in general had less tillering than the late ones.

Chi-square tests of independence between flinty and floury and the following characters in the F<sub>2</sub> showed no association: leaf feeding, overall damage, rind-hardness, maturity, tillering and stalk breakage.

Microfilm copy of complete manuscript of 95 pages, \$1.19. Enlargements 6" x 8", 10¢ per page.

1. Powers, LeRoy, L.F. Locke, and J.C. Garrett, "Partitioning method of genetic analysis applied to quantitative characters of tomato crosses." U.S.D.A. Tech. Bul. 998. 1950.
2. Mather, K., "Biometrical Genetics," Dover Publications, Inc., New York. 158 pp. 1949.

**THE RELATIONSHIP OF VARIOUS AGRONOMIC AND MALTING CHARACTERS OF BARLEY AS STUDIED IN TEN CROSSES HAVING MARS AS A COMMON PARENT AND IN TWO GENERATIONS**

(Publication No. 3087)

Ching Heng Hsi, Ph.D.  
University of Minnesota, 1951

The present study consisted of two major phases: 1) interrelationships of eight agronomic characters, average kernel weight, weight uniformity, general fertility, fertility ratio, head density, yield, bushel weight, date of heading, and three malting characters, barley protein, barley diastatic power, and barley extract as studied in F<sub>5</sub> and F<sub>6</sub> generations of ten crosses involving Mars as a common parent, and 2) heritability estimates of these 11 characters plus two agronomic characters, plant height and head erectness as expressed by the simple correlation coefficients between the same characters in F<sub>5</sub> and F<sub>6</sub> generations of breeding.

Statistically significant differences existed between lines in each of the ten agronomic characters. Although determinations of the three malting characters were made on non-replicated, composite samples, the range of variation of each was great. The material was thus considered suitable for correlation studies.

In both the F<sub>5</sub> and F<sub>6</sub> generations average kernel weight, bushel weight, yield, and extract were significantly positively correlated in all combinations. Consistent significant positive associations were also present between: protein and diastatic power, and head density and general fertility. Significant negative associations were found between: weight uniformity and yield, yield and date of heading, protein and extract, and diastatic power and extract. The association between yield and date of heading was somewhat stronger in F<sub>5</sub> than in F<sub>6</sub>.

No apparent associations in F<sub>5</sub> but significant positive associations in F<sub>6</sub> existed between: average kernel weight and weight uniformity, and weight uniformity and date of heading. The reverse was true for the associations between: fertility ratio and date of heading, and diastatic power and date of heading. Significant negative associations in F<sub>5</sub> but no apparent associations in F<sub>6</sub> were found between: weight uniformity and bushel weight, and extract and date of heading. The situation was just the opposite for the associations between: average kernel weight and general fertility, general fertility and bushel weight, and general fertility and date of heading. In F<sub>6</sub> negative associations existed between fertility ratio and protein, and fertility ratio and diastatic power, but the associations in F<sub>5</sub> with respect to these two combinations were variable. There was a slight positive association between protein and date of heading in F<sub>5</sub>, but in F<sub>6</sub> a slight negative association was found between the same two characters. Significant negative associations in F<sub>5</sub> but significant positive associations

in F<sub>6</sub> existed between: average kernel weight and date of heading, and bushel weight and date of heading. Half of the 16 correlation coefficients which disagreed either in magnitude or in direction involved date of heading as a common variable.

Within the same generation, partial correlation coefficients of the 8th order for average kernel weight, weight uniformity, general fertility, fertility ratio, yield, bushel weight, protein, diastatic power, extract, and date of heading generally corresponded with the simple correlation coefficients in both magnitude and direction.

Partial correlation coefficients of the 1st order for protein, diastatic power, and extract showed the same relationships as in the simple correlations except that in the partials diastatic power and extract were not correlated.

Average kernel weight appeared to have little or no influence on the inter-relationships of the three malting characters as indicated by the partial correlation coefficients of the 2nd order for average kernel weight, protein, diastatic power and extract.

The high inter-generation correlations for head density, date of heading, and diastatic power suggest that effective selection for these characters can be made within lines in early segregating generations. The low inter-generation correlations for average kernel weight, general fertility, yield, bushel weight, protein, extract, weight uniformity, fertility ratio, plant height, and head erectness suggest that little if any gain can be expected by selection within lines, and that selection for these characters becomes effective only on a progeny mean basis.

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**ANIMAL HUSBANDRY**

**A STUDY OF SELECTION FOR FACTORS OF PERFORMANCE IN THE SWINE HERDS OF THE HORMEL FOUNDATION**

(Publication No. 3084)

Richard A. Damon, Ph.D.  
University of Minnesota, 1951

Data from the Chester White and Duroc herds of swine maintained at the Hormel Institute at Austin, Minnesota were analyzed to determine the amount of selection pressure applied toward the improvement of three measures of sow productivity and to determine how well the selection pressure explained the performance of the herds. The three traits considered were: number of live pigs farrowed; number of pigs weaned; and average weaning weights. Information was available for 1685 litters in the Chester White herd and 391 litters in the Duroc herd, extending over a period of six years. Farrowing in both herds took place in every month of the year, with no emphasis on any particular month.

Correction factors were developed in order to remove the effects of age of the dams on their performance records for the number of pigs farrowed, the number of pigs weaned and the average weaning weights.

A consistent and substantial improvement in the management of the herds was demonstrated. A method, based on within generation regression, was devised to measure this managerial trend in order to apportion properly the improvement due to management and the improvement due to genetic gains.

Genetic improvement expected to result from selection was estimated by the product of the selection differential and the coefficient of heritability appropriate to the trait under consideration. Actual changes in performance were calculated by the linear regression of average annual performance on years. The average annual change in performance which was attributed to genetic improvement was calculated by the subtraction of the annual change estimated to be due to environment from the actual average annual change.

The genetic improvement expected to result from selection for an increase in the number of live pigs farrowed was shown to be in reasonably close agreement with the actual increase attributed to genetic improvement for both the Chester White and Duroc herds.

Estimates of the intensity of selection for an increase in the number of pigs weaned indicated the expectation of substantial gains. In the Chester White herd the actual gain was less and in the Duroc herd the actual gain was more than expected through mass selection. Because of a disease problem in the herds, it was impossible to estimate the amount of improvement to be attributed to improved management, so measures of the amount of actual genetic change could not be made.

The genetic improvement expected to result from selection for an increase in average litter weaning weight was found to agree quite closely with the actual increase attributed to genetic improvement in both the Chester White and the Duroc herds.

The intensity of selection practiced in the Hormel herds was shown to be generally greater than that practiced in other herds reported in the literature. In both herds the actual selection differentials which were attained for litter size at birth and at weaning were substantially larger than would have occurred through automatic selection.

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#### A STUDY OF SIZE OF SAMPLE IN LITTER TESTING SWINE

(Publication No. 3165)

Kuo Hwa Lu, Ph.D.  
University of Minnesota, 1951

Litter testing is a form of progeny test employed by the swine industry. It generally consists of the following:

1. A sample of pigs is chosen from the litter as the test lot and sent to the testing station. These pigs may either be chosen at a certain weight or at a specific date of age.

2. The test lots are fed a standard ration which varies with age and kept under uniform housing conditions.

3. The feed consumption and the individual rate of gain are recorded until the test lot pigs reach the slaughter weight. The pigs are then slaughtered. The individual measurements and quality of the carcasses are recorded. The performance of the test lot is taken as the performance of the litter. Reports are consequently made and sent to the owner and the related authorities.

In Denmark, the Netherlands, and Canada, the test lot consists of two barrows and two gilts chosen by the owner. In Hanover, Germany, the sampling procedure is the same but the test lot only consists of one barrow and one gilt.

In Great Britain and Sweden, the test lot also consists of two barrows and two gilts, but the test lot pigs are requested to approximate the litter average as close as possible.

The objectives of this study are 1) to determine the effectiveness of different sampling methods and 2) to determine the sizes of samples required by different sizes of litters for such testing.

A total of 161 litters of Poland China swine, consisting of 1285 pigs, 646 males and 639 females were chosen for this study. The characteristics of litter performance studied were: 1) weaning weight (56 days of age), 2) final weight (154 days of age), 3) rate of gain (daily gain from 56 to 154 days of age) and 4) body score.

Four sampling methods were studied. They were 1) Pigs approximating litter weaning weight with equality of sex (equivalent to the British and the Swedish systems), 2) Random selection with equality of sex, 3) Heaviest pigs at weaning with equality of sex (equivalent to the Danish system), and 4) Random selection disregarding sex. The correlation between performances of litter and sample was used as the measure of the effectiveness of different sampling methods. According to their relative effectivenesses, the four sampling methods ranked as (1), (2), (3) and (4). Method (1) was recommended.

The size of sample was determined by the regression of Y (the correlation between the performances of litter and sample) on X (the sample/litter ratio). The regression equation of method (1) is:  $Y = .8536 + .1528X$  with a standard error of estimate of .0215. According to the regression equation, testing 30.37% of the litter would, on the average, yield a correlation between the performances of litter and sample of .90. The recommended sample sizes were four pigs for litters of 12 or fewer pigs weaned and six pigs for litters of 13 or more pigs weaned respectively. The four-pig samples were considered adequate in most instances.

For large scale official testing, this type of litter testing is practical because of its uniformity of the test lots and the less space, labor and expense involved. It is useful for sire and dam proving programs and the selection between litters. However, if

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rapid improvement is expected, the entire litter should be tested; for by so doing, it permits not only the proving of sire and dam and the selection between litters, but also individual appraisal from within each litter.

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## ANTHROPOLOGY

### A COMPARATIVE STUDY OF THE PRECERAMIC OCCUPATIONS OF NORTH AMERICA

(Publication No. 3513)

Wesley Robert Hurt, Jr., Ph.D.  
University of Michigan, 1952

The purpose of this report is to demonstrate that since the initial immigration of man into the New World the area of the United States contained a series of widely distributed and closely integrated groups of cultural complexes. Although this observation may be generally acknowledged, as yet no classification of the preceramic traditions exists which embraces the entire area of the United States. To the present the scientific investigation of North American archaeology has concentrated its investigations on a regionalistic basis, employing diverse terminology and taxonomic devices.

Important to archaeological classification is chronology, in turn closely linked with geological time period. In Chapters I, II, and III the geological time periods during the Wisconsin glaciation and post-glacial stages are discussed. A standardized classification of the geological substages and their probable dates according to the radiocarbon calendar is proposed.

Chapter IV discusses the various preceramic sites according to their age and environment. The dates are obtained by evidence from geochronology, botany, biology, and the radiocarbon technique. The following section discusses the association of fossil mammals with the early man sites.

The remainder of the study is devoted to the classification of the preceramic sites on the basis of cultural content. Large areas of the United States are compared. The various sites are placed in a series of complexes and traditions, or standardized classificatory categories.

Major points made in this paper are: 1) man entered the New World before the Mankato glaciation; 2) the earliest cultures may have been characterized by lanceolate stone projectile points, although a non-stone-projectile point tradition may have been earlier; 3) in material culture a large number of widespread traits were invented in North America, so that Asia cannot be considered the sole fountainhead of culture; 4) the distribution of the early hunting traditions is closely related to the changing environment; 5) some of the preceramic traditions attained almost country-wide distribution; and 6) the cultural centers in North America shifted with environmental changes.

Microfilm copy of complete manuscript of 605 pages, \$7.57. Enlargements 6" x 8", 10¢ per page.

### TAKASHIMA, A FISHING COMMUNITY OF JAPAN

(Publication No. 3541)

Edward Norbeck, Ph.D.  
University of Michigan, 1952

The objectives of this study are three-fold, to provide ethnographic data on rural Japan, to describe changes in rural Japanese culture which have occurred as the result of contact with Western cultures, and to attempt an analysis of the processes which underlie the changes.

The ethnographic data presented are based principally upon field work done in the fishing community of Takashima, located in the Inland Sea in Okayama Prefecture. It is thought that the observations made in this study apply in some measure to all of rural Japan. The first six chapters are devoted to an ethnographic description of Takashima. An attempt is made in these chapters to present an overall description; no marked emphasis is given to Western culture elements evident. The seventh and last chapter is devoted to consideration of aspects of Westernization and cultural processes.

It was found that there is no aspect of the culture of Takashima in which Westernization is not in some way evident. Changes in some sectors of culture are, however, internal developments which appear to be the result of other and Western-inspired changes. The major changes observed may be summed up as the adoption of a money economy with attendant emphasis upon individuality and a decrease in communal activity; social status based largely on wealth; the gradual breaking down of family ties; a tendency toward ever-larger community structure; the end of isolation and self-sufficiency for the small community; the adoption of many Western objects and ideas, and a decline in religious faith. Changes in social structure and religious practices appear to be principally internal developments.

It is felt that to gain an understanding of the processes of culture change a view of culture as a composite, interacting whole and an analysis of the changes themselves are of primary importance. The fact that the changes are largely Western-inspired is in this connection relatively insignificant. It is urged that large-scale comparative analysis be made of the effects of change in one part of culture upon another, basing the analysis upon observation of many changed and changing cultures.

It is concluded that the altered social structure of Takashima is the result of the industrialization of Japan as a whole with its attendant train of events which include the adoption of a money economy and an emphasis upon individuality at the expense of communalism. The decline in religious faith is concluded to be a natural concomitant of the advance of scientific knowledge, which has provided naturalistic explanations for much that was once thought of supernaturalistic origin and which has rendered unnecessary recourse to magico-religious practices for treatment of illness or injury. It is finally concluded that the ultimate basis for these indirect changes appears to rest upon the changed technology of Japan as a whole, and it is suggested that social structure, if not a

function of technology, is at least closely correlated with it.

Microfilm copy of complete manuscript of 426 pages, \$5.33. Enlargements 6" x 8", 10¢ per page.

## ASTRONOMY

### STARK EFFECT IN BRACKETT $\gamma$ OF SOLAR SPECTRUM

(Publication No. 3522)

Shu-mu Kung, Ph.D.  
University of Michigan, 1952

This is an investigation of the line of profile of Brackett  $\gamma$  in the solar spectrum. This line is of interest because it owes its great breadth to the interatomic Stark effect.

The calculation of the intensities of the Stark components is carried out according to Gordon's formula. In calculating the absorption coefficient at different distances from the line center, Holtsmark's distribution function for the interatomic electric field is employed. The electric field is expressed in units of a normal field which is a function of the temperature and the electron pressure of the layer of the solar atmosphere in question. The distribution of temperatures, pressures, and mean absorption coefficients is adopted from a model solar atmosphere calculated at the University of Michigan. It is assumed that the absorption line is formed according to the mechanism of local thermodynamical equilibrium. Accordingly, the Planck function is adopted as the source function.

Tracings of Brackett  $\gamma$ , with the slit placed at distances 0.0, 0.6, 0.8, 0.9, 0.95, and 0.98 of the solar radius from the center of the solar image, were taken at the McMath-Hulbert and Mount Wilson Observatories. A general description of observations and of instruments is given.

The computed line profiles are systematically deeper than the observed ones. The discrepancy can be explained by supposing that the population of the 4th level in the hydrogen atom is given by the Boltzmann formula with an excitation temperature about ten per cent lower than the local temperature given by the energy density. Also, the theory of the continuous absorption coefficient in the neighbourhood of Brackett  $\gamma$  may be inadequate. The great breadth of the Brackett  $\gamma$  line is well explained by the theory of the Stark effect. Furthermore, the assumed temperature distribution need not differ by more than ten per cent from the excitation temperature distribution.

Microfilm copy of complete manuscript of 53 pages, \$1.00. Enlargements 6" x 8", 10¢ per page.

## BIOLOGICAL CHEMISTRY

### STUDIES ON GLYOXALASE

(Publication No. 3528)

Leo Lutwak, Ph.D.  
University of Michigan, 1952

1. Glyoxalase, the enzyme which catalyzes the dismutation of methylglyoxal into lactic acid, has been shown previously to be present in most living cells. At one time, the enzyme was considered to be an important agent in carbohydrate metabolism, but this view is no longer accepted. At present, the role of glyoxalase in tissue metabolism is unknown. This research was undertaken with the expectation that by isolation and purification of the enzyme, a somewhat clearer insight into the function of glyoxalase might be attained.

2. Mammalian erythrocytes were selected as a convenient source of glyoxalase since solutions, rich in the enzyme, may be obtained by simple hemolysis. A large number of experiments are described which were designed to isolate and purify the glyoxalase of swine red blood cells.

3. The results of the attempts to isolate glyoxalase indicate that the dismutation of the substrate is the result of the action of two enzymes. These two compounds have been called Glyoxalase I and Glyoxalase II. Some progress has been made in the separation of the two compounds from the hemolysates and from each other.

4. The activities of glyoxalase I and glyoxalase II towards methylglyoxal are not particularly high. When the two enzymes are combined, the resulting activity is greater than the arithmetical sum of the individual activities. In a system which contains glyoxalase I and glyoxalase II, together with an excess of the substrate, methylglyoxal, and the coenzyme, glutathione, the concentration of the glyoxalase II appears to be the limiting factor in the reaction. Any increase in the concentration of glyoxalase II increases the rate of the dismutation of the substrate.

5. The activity of glyoxalase I towards phenylglyoxal is less than it is towards methylglyoxal, whereas glyoxalase II appears equally active towards the two substrates. Combination of the two enzymes did not increase the rate of dismutation of phenylglyoxal in the manner that was observed with methylglyoxal. It is suggested that phenylglyoxal acts as a non-competitive inhibitor in the glyoxalase system and the evidence for such a view is presented.

6. A mechanism is proposed for the dismutation in which it is suggested that glyoxalase I catalyzes the formation of an addition compound between methylglyoxal and glutathione and that glyoxalase II is concerned with the actual rearrangement of the glyoxal into lactic acid. Evidence in support of this mechanism is presented.

Microfilm copy of complete manuscript of 169 pages, \$2.11. Enlargements 6" x 8", 10¢ per page.

## STUDIES OF HEMOGLOBIN DEGRADATION

(Publication No. 3535)

Gordon Candee Mills, Ph.D.  
University of Michigan, 1951

It is generally accepted that biliverdin is formed as a result of hemoglobin degradation in the animal body. There is considerable doubt, however, as to the nature of the intermediate products of this degradation. Originally, hematin and protoporphyrin were thought to be intermediates, but recent chemical studies, in which hemoglobin was oxidized to choleglobin, have indicated that this latter compound may be an important intermediate in this conversion. The studies in this thesis were carried out in order to gain more information concerning the mechanisms involved in the physiological breakdown of hemoglobin.

The general procedure which was employed in this research, was the study of the changes in the absorption spectrum of rat hemoglobin after incubation with ascorbic acid or with various rat tissue preparations.

Hemoglobin was converted into choleglobin by liver, kidney and spleen minces and by liver homogenates at a pH of 9. At a pH of 7, the amount of choleglobin formed by these preparations was too small to be detected by the methods used in these experiments. The choleglobin formation from hemoglobin by liver minces may be a normal phenomenon, which at a pH of 9, is proceeding at an increased rate.

When the incubations were conducted at a pH of 9, a decrease in the oxygen tension over the incubation samples brought about an increase in the rate of choleglobin formation. A decrease in the oxygen tension brings about a similar increase in the choleglobin formation from hemoglobin by ascorbic acid.

If the choleglobin solutions, which were formed from hemoglobin by incubation with liver minces, were treated with acetic acid, small amounts of biliverdin could be separated from the solutions by an ether extraction. This indicates that the products of the reaction are intermediates between hemoglobin and biliverdin.

The results of other experiments showed that the factor which was responsible for the choleglobin formation was dialyzable and heat stable. Consequently it would appear that enzymes are not directly involved in the choleglobin formation. It is possible that ascorbic acid may be the factor in these liver preparations which causes the choleglobin formation from hemoglobin.

Studies on the formation of choleglobin by ascorbic acid from solutions of crystalline hemoglobin have confirmed the results of previous workers. Similar studies with solutions of laked red blood cells demonstrated the presence of a factor in the red blood cell which had not been recognized heretofore. This erythrocyte factor, in conjunction with reduced glutathione, inhibits the formation of choleglobin from hemoglobin. This glutathione - erythrocyte factor system is probably important in the protection of the hemoglobin of the red cell from oxidation.

Microfilm copy of complete manuscript of 210 pages, \$2.63. Enlargements 6" x 8", 10¢ per page.

## THE EFFECTS OF ADMINISTRATION OF TESTOSTERONE ON THE FROG

(Publication No. 3451)

Paul Francis Foley Nace, Ph.D.  
New York University, 1951

## The Problem

The histological structure of the liver in testosterone anaesthesia was investigated in experiments employing fifty female frogs, Rana pipiens.

## Procedure

After six weeks of inanition and treatment with several liver poisons, experimental animals were injected intraperitoneally with free testosterone, in anaesthetic dosages, of approximately one milligram per gram of body weight. A control group was injected with comparable volume of vehicle, aqueous gum acacia, after similar inanition and poison treatment. Another group was subjected to inanition and poison without vehicle or hormone injection.

Testosterone-injected animals were observed closely in anaesthesia. At intervals, from six hours to ten days after injection, experimental animals were dissected and their livers fixed. Animals from both control groups were dissected and fixed at the same time. Their livers were carried through dehydration, imbedding and staining simultaneously with those of the experimental animals.

One lobe of each liver was fixed in Bouin's fluid; the rest of each liver in Heidenhain's "Susa" fluid. Tissues were dehydrated in alcohol and imbedded in Tissumat. Blocks were sectioned serially at ten micra.

Sections were mordanted in Zenker stock solution, followed by iron alum, before staining with dilute aqueous hematoxylin. This stain was differentiated in iron alum. Sections were then stained with a modified Masson polychrome stain.

Comparable sections of the livers of experimental and control animals were stained with Gallo-cyanin Chrome Alum, for the identification of nucleic acid, in place of the routine Masson stain.

Photographs, for the ten plates provided, were taken with a ninety diameter oil immersion lens and enlarged to a final plate magnification of twenty-five hundred diameters.

## Results

Livers of hormone-injected animals differed from those of control animals in three features:

Basophil bodies, prominent in the cytoplasm of control animals, were not seen in livers of hormone-injected animals,

Bile canaliculi, very fine or undiscernible in control livers, were very large and prominent in livers of hormone-injected frogs,

Intracellular canaliculi, not found in control livers, were seen in the livers of half of the testosterone-treated frogs.

The intense, selective staining of the cytoplasmic basophil bodies by Gallocyanin Chrome Alum indicated the presence of nucleic acid in these bodies, in control animals. Sections of livers of testosterone-treated animals showed no Gallocyanin stained granules in the cytoplasm.

It was concluded that the structure of the liver of testosterone-treated frogs differed from that of control animals in three prominent features, the bile canaliculi, the cytoplasmic basophil bodies and the intracellular canaliculi. No other morphological differences were found consistently.

Microfilm copy of complete manuscript of 123 pages, \$1.54. Enlargements 6" x 8", 10¢ per page.

#### KINETICS AND MECHANISMS OF THE LIPOXIDASE CATALYZED OXIDATION OF LINOLEATE

(Publication No. 3085)

Aloys Louis Tappel, Ph.D.  
University of Minnesota, 1951

Elucidation of the mechanism of lipoxidase catalysis and the manner of inhibition of the lipoxidase reaction by antioxidants would be an important contribution to our knowledge of biological oxidations and food preservation. With this objective in view, the experiments reported in this thesis were designed to increase our understanding of the mechanism of lipoxidase catalysis and antioxidant inhibition.

An analytical technique of increased sensitivity for measurement of the conjugation resulting from linoleate oxidation was developed. The direct spectrophotometric method consisted of measuring at fifteen second intervals the spectral absorption at  $2325^{\circ}\text{A}$  as the lipoxidase reaction was allowed to proceed in thermostated silica cuvettes.

Kinetic studies in the temperature range  $-6^{\circ}$  to  $30^{\circ}\text{C}$ . were used to evaluate the activation energy for the lipoxidase catalyzed reaction as 4,300 calories per mole. The Michaelis constant for the reaction with linoleate was found to be  $2 \times 10^{-6}\text{M}$ . The constant for oxygen cannot be determined in the usual manner because of linoleate inhibition. Apparently, at high linoleate concentrations the linoleate molecules can block the oxygen absorption site on the lipoxidase.

All of the eight antioxidants tested were found to inhibit linoleate oxidation. Some of the antioxidants like  $\alpha$ -tocopherol and hydroquinone were oxidized rapidly in the lipoxidase system and, therefore, the total oxidation rate was not greatly lowered. The more powerful antioxidants like nordihydroguaiaretic acid (N.D.G.A.) and propyl gallate are effective inhibitors at concentrations approximately  $3 \times 10^{-4}\text{M}$ . N.D.G.A. can completely inhibit linoleate oxidation and oxygen absorption because it reversibly inactivates the lipoxidase. Using N.D.G.A. as a model antioxidant the two effects of the antioxidants were

demonstrated. First, antioxidants are oxidized by the lipoxidase-linoleate-oxygen complex. Second, inhibition is due to inactivation of the lipoxidase.

Experimental evidence indicated that the lipoxidase mechanism does not consist of a chain reaction, but rather follows the pattern of most enzyme reactions. Completely conjugated peroxides resulting from lipoxidase catalysis are most likely formed when the linoleate is combined with lipoxidase. Autoxidation, a probable chain reaction, produces only seventy per cent conjugated peroxides. The reaction velocity of linoleate oxidation is directly proportional to the lipoxidase concentration and no initial inhibition period was found indicating that the reaction is enzymatic and not a chain type. A hyperbolic relationship between reaction velocity and linoleate concentration does not fit the kinetics of a chain reaction but is typical of most enzyme reactions. It is very unlikely that inhibition by antioxidants could be due to interruption of a chain reaction.

A mechanism of the lipoxidase catalyzed reaction which is in harmony with the experimental observations is postulated. It is proposed that the lipoxidase catalyzes the reaction in which transfer of a hydrogen atom and electron from linoleate to oxygen proceeds with the formation of two free radicals. The linoleate free radical reacts with the  $\cdot\text{OOH}$  radical only after a shift of the double bonds into the conjugated position. The free radicals formed initially are stabilized by lipoxidase and may accept hydrogens from antioxidants and other easily oxidizable substances and in such a manner catalyze oxidation of these substances.

The lipoxidase catalyzed reaction in foods may be inhibited by temperature lowering, freezing, addition of antioxidants like N.D.G.A. and propyl gallate, reduction of oxygen concentration, and heat denaturation of the enzyme.

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#### BIOLOGY

#### A PLEXIGLAS CHAMBER FOR THE STUDY OF LIVING BLOOD VESSELS IN THE DOG'S EAR

(Publication No. 2965)

Harry Witherow Hays, Ph.D.  
Princeton University, 1940

Abstract not available.

Microfilm copy of complete manuscript of 56 pages, \$1.00. Enlargements 6" x 8", 10¢ per page.

**ADRENALECTOMY IN THE FROG (*Rana pipiens*)**  
 (Publication No. 3051)

Alton Robert Taylor, Ph.D.  
 Princeton University, 1939

Abstract not available.

Microfilm copy of complete manuscript of 61 pages, \$1.00. Enlargements 6" x 8", 10¢ per page.

**BOTANY**

**THE PTEROBRYACEAE OF THE SOUTHERN UNITED STATES, MEXICO, CENTRAL AMERICA, AND THE WEST INDIES**

(Publication No. 3463)

Charles Basel Arzeni, Ph.D.  
 University of Michigan, 1952

This is a study of the taxonomy and distribution of the mosses belonging to the family Pterobryaceae as they occur in the southern United States, Mexico, Central America, and the West Indies. The area bordering the Gulf of Mexico marks the northern limits of the group in the United States.

This pantropic family of epiphytic mosses widely distributed in both the old and new world, includes twenty one genera. The family is divided into three tribes: the Trachylomeae (three genera), the Garovaglieae (three genera), and the Pterobryeae (fifteen genera). The tribe Pterobryeae is the only one occurring in the western hemisphere; seven of the genera in this tribe (Pirella, Pterobryon, Pterobryopsis, Orthostichopsis, Orthostichidium, Renaudia, and Jaegerina) occur in the area under consideration. The morphological characters used to distinguish the genera and species were evaluated. Keys, descriptions, and illustrations of these are herein presented.

Pterobryopsis, Jaegerina, Renaudia, Orthostichidium, and Pirella, are widespread or pantropic genera. Pirella (eleven species and a variety), is the largest genus of this family in the area. Pterobryon and Orthostichopsis are the only genera which show a marked discontinuous distribution. Orthostichopsis tetragona is the most widely distributed species of the family within the area. Over seventy per cent of the genera of the area occur in Central America, sixty five per cent in the West Indies, fifty per cent in Mexico, and only fifteen per cent in the southeastern United States. Distribution maps have been included for each species. The Pterobryaceae appear to be most closely related to the family Meteoriaceae, particularly through the genera Pilotrichella and Meterium of the latter family.

Of the sixty five species, varieties, and forms reported, forty four are synonyms, so that in the present work the number has been reduced to nineteen species, and one variety. One species and one variety are new. Three of the species have been excluded since they belong to another family, the

Meteoriaceae. The following list represents the changes in nomenclature:

New species and varieties:

Pirella guatemalensis Bart. var. mexicana Arzeni  
Pirella squarrosa Arzeni

New combinations:

Jaegerina scariosa (Lor.) Arzeni  
Pirella angustifolia (C. M.) Arzeni

Species referred to synonymy:

Hildebrandtiella tetragona (Hedw.) Paris = Orthostichopsis tetragona (Hedw.) Broth.  
Isothecium tetragonum Brid. = Orthostichopsis tetragona (Hedw.) Broth.  
Jaegerinopsis(?) ramosa Thér. = Pirella cavifolia (Card.) Card.  
Jaegerinopsis scariosa (Lor.) Broth. = Jaegerina scariosa (Lor.) Arzeni  
Jaegerinopsis squarrosa E.G.B. = Jaegerina scariosa (Lor.) Arzeni  
Meterium excavatum Mitt. = Orthostichidium pentagonum (Hampe & Lor.) C.M.  
Meterium mexicanum Mitt. = Renaudia mexicana (Mitt.) Crum  
Meterium scariosum Lor. = Jaegerina scariosa (Lor.) Arzeni  
Meterium tetragonum Mitt. = Orthostichopsis tetragona (Hedw.) Broth.  
Neckera ludoviciae C.M. = Pirella pohlii (Schwaegr.) Card.  
Neckera quinquefaria C.M. = Orthostichopsis tetragona (Hedw.) Broth.  
Neckera tetragona C.M. = Orthostichopsis tetragona (Hedw.) Broth.  
Orthostichella crinita Hampe = Orthostichopsis crinita (Sull.) Broth.  
Orthostichidium excavatum (Mitt.) Broth. = Orthostichidium pentagonum (Hampe & Lor.) C.M.  
Orthostichidium subtetragonum C.M. = Orthostichidium pentagonum (Hampe & Lor.) C.M.  
Pilotrichella longipes (C.M.) Jaeg. = Pirella pohlii (Schwaegr.) Card.  
Pilotrichella tetragona Besch. = Orthostichopsis tetragona (Hedw.) Broth.  
Pilotrichella pentagona Jaeg. = Orthostichidium pentagonum (Hampe & Lor.) C.M.  
Pilotrichum angustifolium C.M. = Pirella angustifolia (C.M.) Arzeni  
Pilotrichum cochlearifolium C.M. (1851) = Renaudia mexicana (Mitt.) Crum  
Pilotrichum filicinum Palis. de Beauv. = Pirella filicina (Hedw.) Card.  
Pilotrichum hornschuchii C.M. = Pterobryon densus (Schwaegr.) Hornsch.  
Pilotrichum ludoviciae Jaeg. = Pirella pohlii (Schwaegr.) Card.  
Pilotrichum tonduzii Ren. & Card. = Pirella pohlii (Schwaegr.) Card.  
Pirea papillosum Card. = Pirella pohlii (Schwaegr.) Card.  
Pirea tonduzii (Ren. & Card.) Broth. = Pirella pohlii (Schwaegr.) Card.

- Pirella cubensis Card. & Thér. = Pirella pachyclada (Ren. & Card.) Card.  
Pirella denticulata Card. & Thér. = Pirella cymbifolia (Sull.) Card.  
Pirella ludoviciae (Ren. & Card.) Card. = Pirella pohlii (Schwaegr.) Card.  
Pirella panamensis (Broth. & Paris ined., nomen) Card. = Pirella filicina (Hedw.) Card.  
Pirella papillostula (Card.) Card. = Pirella pohlii (Schwaegr.) Card.  
Pirella tonduzii (Ren. & Card.) Card. = Pirella pohlii (Schwaegr.) Card.  
Prionodon splendens Herzog = Pterobryon densum (Schwaegr.) Hornsch.  
Pterigynandrum quadrifarium Brid. = Orthostichopsis tetragona (Hedw.) Broth.  
Pterobryopsis scariosa (Lor.) Fleischer = Jaegerina scariosa (Lor.) Arzeni  
Pterobryum angustifolium (C.M.) Mitt. = Pirella angustifolia (C.M.) Arzeni  
Pterobryum angustifolium forma flagellifera Besch. = Pirella angustifolia (C.M.) Arzeni  
Pterobryum cochlearifolium (C.M.) Jaeg. = Renaudia mexicana (Mitt.) Crum  
Pterobryum densum var. peracuminatum Card. = Pterobryon densum (Schwaegr.) Hornsch.  
Pterobryum filicinum (Hedw.) Mitt. = Pirella filicina (Hedw.) Card.  
Pterobryum integrifolium Hampe = Pirella angustifolia (C.M.) Arzeni  
Pterobryum ludoviciae (C.M.) Broth. = Pirella pohlii (Schwaegr.) Card.  
Pterobryum panamense Thér. = Pterobryon densum (Schwaegr.) Hornsch.  
Renaudia cochlearifolia (C.M.) Broth. = Renaudia mexicana (Mitt.) Crum

Excluded species:

- Pterobryopsis subcochlearifolia Thér. in Hb., is Pilotrichella flexilis (Hedw.) Jaeg.  
Pterobryopsis dentata Thér. Trav. Bryol., Musci Hispan. 18-19. 1944, belongs to the genus Meteoriom.  
Renaudia subpilifera Williams, Journ. Washington Acad. Sci. 20(10): 176. 1930, is Pilotrichella cuspidans Ren. & Card.

Microfilm copy of complete manuscript of 248 pages, \$3.10. Enlargements 6" x 8", 10¢ per page.

THE APPALACHIAN-OZARKIAN ELEMENT IN  
THE MOSS FLORA OF MEXICO WITH A  
CHECK-LIST OF ALL KNOWN MEXICAN MOSSES

(Publication No. 3486)

Howard Alvin Crum, Ph.D.  
University of Michigan, 1952

The known moss flora of Mexico comprises 838 species and varieties, 250 of which also occur in the United States. This study is an attempt to analyze the

floristic relationships of temperate mosses in Mexico and to determine the probable origin and migration of those which occupy disjunct ranges in Mexico and eastern United States.

A check-list of Mexican mosses is presented; it includes literature citations, lists of synonyms, taxonomic notes and distributions. Whenever possible the position of names in synonymy and the authenticity of previous distribution records were confirmed. Many species are reduced to synonymy; nine new combinations and two changes of status are reported.

Excluding very wide-ranging species, 59.7 per cent of the species common to Mexico and the United States occur in eastern North America, but only 33 per cent are truly temperate in distribution. A total of 40.7 per cent range into western North America, but, after excluding northern species extending only to northernmost Mexico and Mexican species found only in parts of the Southwest adjacent to Mexico, the percentage is reduced to 16.2.

Because these mosses are associated in Mexico and in the Appalachian-Ozarkian region with a large number of genera of angiosperms believed to have originated in the Arctic-tertiary flora, the fossil and modern distributions of plants occupying the oldest parts of North America and the physiographic and climatological histories of those areas are reviewed.

Certain mosses of tropical and austral distribution ranging into eastern United States are also discussed. Some of them are limited to the Coastal Plain, but most of them occur less frequently in the uplands. Their distributions seem to support the theory that elements of the Coastal Plain flora were derived from a subtropical flora occupying the Schooley peneplain in mid-Tertiary times. Several other species of tropical distribution are restricted to a few upland localities in the Southern Appalachians. They appear to be relicts of the same subtropical flora.

A small group of xeric species ranging discontinuously from northwestern Mexico to southeastern United States are presented as evidence that elements from an early desert flora may have migrated into the Great Plains in the mid-Tertiary and later penetrated farther into the eastern highlands during a possible xerothemic period following the Pleistocene.

Many higher plants in Mexico were doubtless derived secondarily from the Arctic-tertiary flora, but, with few exceptions, the mosses of similar distribution on this continent are too widely distributed in other parts of the Northern Hemisphere to give any clue to their ultimate origin. It is suggested, however, that these mosses have long been associated with the survivors of the Arctic-tertiary flora and may have originated with them. The low altitudes in Mexico until late Pliocene and Pleistocene times and the dry climate of northwestern Mexico during most of the Tertiary probably did not permit any extensive migration of temperate plants into the country from the West. The meager evidence available indicates that temperate plants probably entered Mexico from the East not earlier than the late Pliocene or Pleistocene when the altitude and climate were conducive to their migration. Such a recent invasion helps to

explain the high degree of specific identities shared by Mexico and eastern United States.

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#### SOME FACTORS AFFECTING THE DISTRIBUTION OF MOSSES IN ARIZONA

(Publication No. 3529)

James Albert McCleary, Ph.D.  
University of Michigan, 1952

It is the purpose of this paper to determine the distribution of the mosses in Arizona, to ascertain the part played by several ecologic factors in this distribution, and to attempt to correlate the geography of Arizona species with known North and Latin American floras.

An annotated list of species, varieties and forms of Arizona mosses is presented. Three hundred and fifteen of the above are reported with forty-five of them being new records for the state. One species, Splachnobryum bernoullii, is excluded. Altitudinal ranges for individual species are determined. Four general groups are found to occur in Arizona: 150-5000 ft.; 4000-9500 ft.; 8000-12,500 ft.; 1100-12,500 ft. Using climatological data of 1940-1950 obtained from the United States Weather Bureau, average annual rainfall and maximum and minimum mean temperatures were obtained for all collecting stations. It was found that Arizona species are grouped into three minimum precipitation ranges: 3-9 inches, 9-15 inches, and 15 inches and above. Most species are capable of withstanding wide temperature ranges although a variation of 10 degree maximum mean temperature is sufficient to allow one group of species to be replaced by another.

Correlations of altitude, temperature and moisture of the moss flora is made with the Arizona phanerogamic flora. The same factors which favor the phanerogamic associations are also responsible for the distribution of the moss flora. Distribution maps for Arizona of fourteen species is given. Acrocarpous mosses, chiefly members of the Pottiaceae predominate in the desert. At higher altitudes, species of the Hypnaceae, Dicranaceae, and Bryaceae appear in greatest numbers. Geographical affinities of Arizona mosses are given. Represented in Arizona are mosses from the eastern North American, western North American, and Latin American floras. Seventeen species are listed as endemic to the state. The need for microclimatological studies is pointed out.

Several general conclusions can be drawn from the study: 1) at altitudes up to 5000 ft., the limiting factor in the distribution of the Arizona moss flora is the amount of precipitation, 2) above 5000 ft. the limiting factor is the maximum mean temperature, 3) the Arizona moss flora is more closely related to eastern North American than is the phanerogamic flora.

Microfilm copy of complete manuscript of 156 pages, \$1.95. Enlargements 6" x 8", 10¢ per page.

#### CHEMISTRY

#### THERMODYNAMICS OF $\beta$ -KHF<sub>2</sub>, INCLUDING HEATS OF DISSOCIATION, OF FUSION, AND OF THE $\alpha$ - $\beta$ TRANSITION

(Publication No. 3487)

Merton Louis Davis, Ph.D.  
University of Michigan, 1952

The experimental part of this work is primarily concerned with the redetermination of certain thermodynamic data on KHF<sub>2</sub> by the application of a method different from those methods used by Westrum and Pitzer (1949). The results serve as an independent check on the heats of dissociation, of fusion, and of the  $\alpha$ - $\beta$  transition. The redetermination of the heat of dissociation, according to  $KHF_2(s,\beta) \rightarrow KF(s) + HF(g)$ , also provides a test of the equilibrium dissociation pressures measured by Westrum and Pitzer.

On the basis of these data, and with related data presented by other investigators, the question of the position of the proton in the (FHF)<sup>-</sup> ion is discussed. Included in the theoretical discussion is a suggestion as to the possible structure of the waxy  $\beta$ -phase.

A vacuum jacketed adiabatic calorimeter was constructed and operated in the temperature range from 185° C to 250° C. It was found that isothermal heat effects of endothermic processes can be determined by introducing known amounts of electrical energy at these elevated temperatures provided care is taken: 1) to avoid, as far as possible, thermal gradients about the calorimeter surface while operating; 2) to assure good thermal contact of all wire leads with the surface of the calorimeter; 3) to begin and end an experimental period having the calorimeter in equilibrium both internally and with respect to its surroundings.

The following experimental results are expressed in calories per mole. The heat of transition at 469.2° K is 2682 ± 9; the heat of fusion at 511.9° K is 1582 ± 3; and the heat of dissociation at 500.0° K is 18,533 ± 25. Considering possible systematic errors in the heat of transition and the value of 2659 ± 10 cal. mole<sup>-1</sup> determined by Westrum and Pitzer, the value, 2668 ± 10 cal. mole<sup>-1</sup>, is taken to be the most reliable.

The calorimetrically determined entropy of dissociation was compared with the calculated absolute entropies of KHF<sub>2</sub>, of KF, and of HF. The result confirms the conclusion of Westrum and Pitzer, who used a value of the entropy of dissociation determined from their dissociation pressure data, that the entropy of KHF<sub>2</sub> at 0° K does not appreciably differ from zero. Hence, if two minima in the potential curve for the proton in the (FHF)<sup>-</sup> ion exist, the height of the barrier between these minima is very small.

The large entropy of transition (5.69 cal. mole<sup>-1</sup> deg.<sup>-1</sup>), the low entropy of fusion (3.09 cal. mole<sup>-1</sup> deg.<sup>-1</sup>), the large increase of volume, the appearance of the  $\beta$ -phase, and a comparison with the properties of other compounds which also have large entropies of

transition at temperatures not far below the melting point, support the contention that the transition in  $\text{KHF}_2$  at  $196.0^\circ\text{C}$  is accompanied by a greater degree of disordering than is normally associated with a simple polymorphic phase transition. It is tentatively suggested that after the transition the  $(\text{FHF})^-$  ions either start to rotate or they release HF which partially remains in random distribution within the solid phase of undissociated  $\text{KHF}_2$ .

In the appendix, a description is given of an experiment in which the electrical conductivity of  $\text{KHF}_2$  was determined from the transition point through the melting point.

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#### SOME ASPECTS OF AROMATIC SUBSTITUTION

(Publication No. 3157)

John Torngren Day, Ph.D.  
University of Minnesota, 1951

The rates of exchange of deuterium from the ortho and para positions of anisole and the para position of phenetole, phenyl-n-propyl ether, and phenyl-iso-propyl ether in acidic media were measured at constant temperature.

The relative rates as tabulated are considered to be a measure of the electron densities of the positions concerned.

#### Relative rates of Deuterium Exchange at $100^\circ\text{C}$

Ortho	Anisole	Phenetole	Phenyl-n-	Phenyl-iso-
	Para	Para	Propyl ether	Propyl ether
	52	100	134	137
				260

The effect produced by varying the alkyl portion of the ether is ascribed to the difference in electronegativity of the alkyl groups. As the series progresses from the methyl ether to the iso-propyl ether, the alkyl portion of the ether becomes less electro negative. This is a result of the greater inductive effect of the group and an increase in the contribution of ionic bond structure to the resonance hybrid of the molecule. With the less electronegative iso-propyl group, an unshared pair of electrons of the oxygen atom is more available for mesomerism with the benzene ring.

The deuterated compounds were prepared by the action of heavy water on the corresponding lithium salt.

No exchange of deuterium was detected in the case of deuteriobenzene and o-deuteriotoluene with perchloric acid in trifluoroacetic acid.

The deuteration of lithium-m-lithium phenoxyde and lithium-p-lithium phenoxyde produced phenol in which the deuterium was present in more than one nuclear position.

Microfilm copy of complete manuscript of 163 pages, \$2.04. Enlargements 6" x 8", 10¢ per page.

#### FLUORESCENCE MEASUREMENTS OF CHLOROPHYLL SOLUTIONS

(Publication No. 3161)

Leslie S. Forster, Ph.D.  
University of Minnesota, 1951

The absolute quantum yields of fluorescence have been determined for chlorophyll a and b, pheophytin a, and mesoporphyrin dimethyl ester by a method involving the use of an integrating sphere. Previous estimations of the yield could claim little accuracy, and an accurate determination was desired because of the relationship of the yield to the mean lifetime of the excited state. The yields of four dyes whose values had been determined by investigators using other methods were redetermined, and the good agreement obtained indicated that the method used in this work was reliable.

This experimental method may be outlined as follows: Vessels containing either a chlorophyll solution or pure solvent were alternately placed in the center of the integrating sphere and blue exciting light allowed to pass through them. A thermopile covered by an appropriate filter was placed in the sphere wall and its output measured. This output was amplified optically and could be measured to 0.01 microvolt. When a blue filter covered the thermopile only the exciting light was allowed to strike the thermopile surface, and the difference in output when the sample and blank vessels were compared corresponded to absorption. When a yellow filter was in front of the thermopile only fluorescence was permitted to pass, and the same difference then corresponded to fluorescence. The ratio of these differences corrected for transmission of the filters and for spectral selectivity of the sphere wall is the energy yield. This is converted to the quantum yield by the usual method. A less direct approach was employed when the chlorophyll was excited with red light.

#### Summary of Results

Substances	Solvent	Excitation Wave-length (A)	
		4360	Yield
Chlorophyll <u>a</u>	Methanol	4360	$0.24 \pm .02$
		6275	$0.24 \pm .03$
		6440	$0.25 \pm .04$
		6620	$0.26 \pm .03$
		4360	$0.24 \pm .02$
	Ether	6275	$0.21 \pm .03$
		6440	$0.24 \pm .03$
		6620	$0.24 \pm .03$
		4360	$0.26 \pm .04$
		4360	$0.26 \pm .04$
Chlorophyll <u>b</u>	Acetone	4360	$0.26 \pm .04$
		4360	$0.26 \pm .04$
	Benzene	4360	$0.26 \pm .04$
	Cyclohexanol	4360	$0.26 \pm .04$
Pheophytin <u>a</u>	Methanol	4360	$0.06 \pm .01$
	Ether	4360	$0.11 \pm .01$
		6440	$0.11 \pm .02$
	Methanol	4060	$0.14 \pm .03$
Mesoporphyrin	Benzene	4060	$0.10 \pm .03$

The absolute yields are given above for various solutions and excitation wave lengths. The

fluorescence and absorption bands overlap a great deal and a substantial portion of the light fluoresced is reabsorbed. When the concentration of chlorophyll *a* in ether is  $2 \times 10^{-6}$  this reabsorption amounts to ten per cent. A correction for this effect was made and the values tabulated are those that would be observed in a very dilute solution.

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**A STUDY OF THE ACTION OF SILVER-CATALYZED PERSULFATE ON 1,2-GLYCOLS**

(Publication No. 3423)

Frank P. Greenspan, Ph.D.  
University of Buffalo, 1951

A new glycol splitting agent, silver-catalyzed persulfate, has been characterized for the first time. Glycol cleavage products, aldehydes, ketones or both, were obtained in moderately good to excellent yields (40%-100%) dependent upon the specific glycol used. The reaction appears to be general for water soluble glycals. Primary and secondary glycals averaged slightly more than 1 mole of aldehyde product per mole of glycol, while a water soluble tertiary glycol gave 2 moles of ketone per mole of glycol.  $\alpha$ -Hydroxy ketones or  $\alpha$ -hydroxy aldehydes were obtained in small amounts as coproducts. Water insoluble glycals were found to be either non-reactive or sluggish with the reagent.

Optimum procedures developed for this reaction require the use of catalytic amounts of silver, 0.002 - 0.01 M  $\text{Ag}^+$  concentration. The reactive intermediate is believed to be  $\text{Ag}^{+3}$  formed by persulfate oxidation of  $\text{Ag}^+$ .

Silver-catalyzed persulfate, unlike lead tetra-acetate and periodic acid, is not specific for 1,2-glycols. Monohydric alcohols and aldehydes react readily with the reagent. Further oxidation of the initial aldehyde cleavage product by the reagent has been shown to be the major factor in depressing the aldehyde yields obtained through glycol cleavage. Higher carboxy acids have been found to interfere by precipitation of the corresponding insoluble silver salt.

The reaction is not general for peroxy acids or salts thereof. Peracetic and mono-persulfuric acids were found not to react with 1,2-glycols in the presence of  $\text{Ag}^+$ . Free  $\text{H}_2\text{O}_2$  interfered with the silver-catalyzed persulfate reaction.

The silver-catalyzed persulfate reaction was extended to  $\alpha$ -hydroxy acids and ethanolamines with resultant C-C cleavage.

Possible mechanisms for the glycol cleavage action of silver-catalyzed persulfate were experimentally examined. Kinetics studies were made on the reaction with the cis and trans cyclohexanediols. Strikingly identical rates of reaction were found for both isomers. A cyclic inner ester mechanism, as proposed by Criegee for lead tetra-acetate and periodic acid, would require a greater rate of reaction for the cis isomer.

The reaction of various reduction-activated ( $\text{Cu}^{+2}$ ,  $\text{Fe}^{+2}$ ) persulfate systems on 2,3-butanediol were studied.  $\alpha$ -Hydroxy ketones, in promising yields in many cases, were obtained without any evidence for glycol cleavage products. Glycol cleavage products would be expected from these reduction-activated persulfate systems if free radicals (from the persulfate) were responsible for the glycol cleavage action of silver-catalyzed persulfate. The formation of  $\alpha$ -hydroxy ketones represents, as far as known, the first demonstration of a Fenton reaction with persulfate and provides further evidence for believing the Fenton reaction to be free radical initiated.

On the basis of the experimental evidence, no mechanism for the glycol cleavage action of silver-catalyzed persulfate can be proposed at this time.

Microfilm copy of complete manuscript of 114 pages, \$1.43. Enlargements 6" x 8", 10¢ per page.

**THE ADSORPTION OF NITROGEN ON CARBON BLACK**

(Publication No. 3424)

Harry Brooks Kirkpatrick, Ph. D.  
University of Buffalo, 1951

It has been shown that there exists an important connection between the surface structure and activity of carbon blacks and their property of reinforcing rubber. Therefore, in order to gain information about the carbon black surface, we have studied the initial adsorption of nitrogen by a commercial channel black, Spheron 6, and a furnace black, Vulcan 1.

It has been found that the adsorption proceeds in a step-wise manner in the pressure range 0.0-7.0 cm and that in this range the fraction of the surface covered is of the order of  $10^{-5}$ . Other workers have shown that the surface is non-homogeneous with respect to the heat of adsorption and it is now suggested that it consists of various distinct classes of adsorption sites having different heats of adsorption. These sites probably consist of crevices, crystallite faces, and the edges of graphitic layers. The steps in the isotherms would then correspond to the saturation of one class of sites and the beginning of adsorption on a new class having a lower heat of adsorption.

In addition to the adsorption studies, we have obtained the electron diffraction patterns of Spheron 6 and Graphon, which is made by heating Spheron 6 to  $2000^\circ \text{C}$ . or higher. The electron diffraction pattern of Spheron 6 closely resembles that obtained with X-rays; it consists of diffuse rings, and it is presumed that these are due to crystalline (002) reflections and two dimensional lattice reflections from a graphitic type of structure. These results indicate the presence of certain ranges of preferred inter-atomic distances but a complete lack of orientation.

In the case of Graphon the electron diffraction pattern consists of fine points which are arranged in concentric circles, representing the same type of reflections as in Spheron 6. The X-ray pattern on the other hand consists of a series of sharp circles. The electron diffraction pattern somewhat resembles that

of finely powdered graphite, and it indicates both angular orientation of the particles and a high degree of order within the individual particles. This orientation of the particles does not appear in the X-rays, which have greater penetration; and it is presumed, therefore, that the orientation is localized and that there is an over-all disorder over greater distances through the mass of particles.

These electron diffraction patterns of Spheron 6 and Graphon can be accounted for by assuming that a Spheron 6 particle consists of an assembly of graphitic layers, each individual layer being bent and puckered so that various sections of it are at all angles to each other. The different layers are randomly rotated with respect to one another and are approximately parallel. Then on heating, the graphitic layers flatten out and the inter-layer spacing becomes more uniform, giving Graphon. With further heating, the planes rotate with respect to each other, the inter-layer distance decreases somewhat, and the particle settles into a true graphite structure.

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#### THE DIETHYL BROMOETHYLMALONATES AS EVIDENCE OF THE EXISTENCE OF ALTERNATE POLARITIES IN SATURATED CARBON CHAINS

(Publication No. 3525)

Seymour Z. Lewin, Ph.D.  
University of Michigan, 1951

A critical review of the evidence and reasoning adduced by many chemists as negating the existence of alternate polarities in saturated carbon chains has been made. Although there does not seem to be any alternation of polarities in a number of series of saturated compounds, it is shown that the generalization that alternate polarities do not exist in any saturated compounds is without justification. In fact, evidence of the existence of alternate polarities has been found by K. Fajans and B. E. Cook in the pronounced alternations in properties of the series of (liquid) tetraalkyls of the Group IV elements.

Further evidence has been found in the present study of the refractometric, volumetric and kinetic properties of the series of isomeric diethyl bromoethylmalonates:  $\text{CH}_3\text{CH}_2\text{CBr}(\text{COOC}_2\text{H}_5)_2$  ( $\alpha$ -Br isomer);  $\text{CH}_3\text{CHBrCH}(\text{COOC}_2\text{H}_5)_2$  ( $\beta$ -Br); and  $\text{CH}_2\text{BrCH}_2\text{CH}(\text{COOC}_2\text{H}_5)_2$  ( $\gamma$ -Br).

In order to obtain pure samples of the last two of the above-mentioned compounds, a new purification technique was devised. It was found that diethyl malonate and its derivatives form addition compounds with anhydrous magnesium perchlorate, and that the stabilities of these addition compounds vary markedly with the structure of the ester. A purification technique based upon these observations was successfully applied to the  $\beta$ - and  $\gamma$ -Br compounds.

The following compounds, which were intermediates in the preparation of the above isomers, have also been obtained in a highly pure state, and their

molar refractions, dispersions and volumes have been measured: diethyl ethylmalonate, diethyl ethylene-nemalonate, diethyl cyclopropane-1,1-dicarboxylate.

Pronounced alternation effects have been found in the following properties of the diethyl bromoethylmalonates: the molar refractions, dispersions and volumes, the rates of isotopic exchange with  $\text{KBr}$  in absolute acetone at  $0^\circ$  and  $23^\circ \text{ C.}$ , the rates of precipitation of  $\text{AgBr}$  by aqueous-alcoholic  $\text{AgNO}_3$  at  $25^\circ \text{ C.}$ , the rates of oxidation of aqueous-alcoholic  $\text{HI}$  at  $25^\circ \text{ C.}$ , the case of dehydrobromination, and the stability on standing. For example, the  $\beta$ -Br isomer has a larger molar refraction ( $R_{D_3} = 55.855 \text{ cc.}$ ), dispersion ( $D_{v-r} = 1.356 \text{ cc.}$ ) and volume ( $V = 207.32 \text{ cc.}$ ) than the  $\alpha$ - (54.903, 1.316, 204.21 cc. respectively) and  $\gamma$ -isomers (55.304, 1.314, 204.27 cc. respectively). The  $\beta$ -Br isomer was more reactive than either of the other two in all the reactions studied.

These facts are considered to be conclusive evidence of the existence of an alternation in the polarity of the bromine as its position is changed from alpha to beta to gamma.

It is shown that the quanticule theory of K. Fajans and associates affords a simple and logically consistent rationale for the interpretation of the properties of these compounds. The following quanticule formulations are proposed for the bromoethylmalonates:  $\alpha$ -Br =  $(\text{CH}_3)^-(\text{CH}_2)^{2+}(\text{C})^{4-}(\text{R}^+)_2$ ;  $\beta$ -Br =  $(\text{CH}_3)^-(\text{CH})^{3+}(\text{CH})^{3-}(\text{R}^+)_2$ ;  $\gamma$ -Br =  $(\text{CH}_2)^{2-}(\text{CH}_2)^{2+}(\text{CH})^{3-}(\text{R}^+)_2$  where  $\text{R}^+ = (\text{COOC}_2\text{H}_5)^+ = \text{Br}^+$

$\begin{matrix} & \text{O}^{2-} \\ & | \\ \text{C}^{4+} & \end{matrix}$   $\begin{matrix} & \text{O}^{2-} \\ & | \\ & \text{C}_2\text{H}_5 \end{matrix}^+$

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#### THE PREPARATION AND REACTIONS OF CERTAIN HINDERED MOLECULES

(Publication No. 3536)

Kirby Mitchell Milton, Ph.D.  
University of Michigan, 1951

The work of many investigators including Hughes and Ingold and their students and recently C. G. Swain has given a fairly clear picture of the displacement reaction in unhindered molecules. P. D. Bartlett and his students, however, have shown that molecules containing a usually reactive group at the bridgehead of a bicyclic ring system are extraordinarily inert either because rear-side attack by nucleophilic reagents, including the solvent, or the formation of a planar carbonium ion are impossible due to the "caged" structure of the compounds studied. The aims of the present work were: 1) to prepare, 2) to determine the configurations of, and 3) to study the substitution reactions of certain compounds in which the group to be replaced is attached to a carbon atom sufficiently

shielded to inhibit a rear attack by an external nucleophilic reagent (or solvent molecule) but whose bond angles are not so rigidly fixed that a planar carbonium ion is impossible.

A study of the preparation of various succinic acid derivatives is given and the following new compounds are reported: methyl dl(*threo*)- $\alpha$ , $\beta$ -dibromo-methylsuccinate, methyl  $\alpha$ -bromomesaconate and  $\alpha$ -acetoxycitraconic anhydride. Greatly improved procedures for the preparation of  $\alpha$ -bromomesaconic acid and dl(*threo*)- $\alpha$ , $\beta$ -dibromomethylsuccinic acid are also given.

The Diels-Alder reaction of anthracene with a number of  $\alpha$ , $\beta$ -unsaturated carboxylic acids is reported. Bromofumaric acid,  $\alpha$ -bromocitraconic anhydride,  $\alpha$ -acetoxycitraconic anhydride, ethyl propionate and tetrolic acid are found to undergo this reaction. Apparently neither  $\alpha$ -bromomesaconic acid nor methyl  $\alpha$ -bromomesaconate will add to anthracene. In addition adducts corresponding to the reaction of anthracene with propionic acid, methyl hydroxymutaric acid,  $\alpha$ -hydroxymesaconic acid, methyl  $\alpha$ -hydroxymesaconate,  $\alpha$ -acetoxymsaconic acid,  $\alpha$ -methoxymesaconic acid,  $\alpha$ -hydroxycitraconic anhydride, methyl tetrolate, the  $\beta$ -half methyl ester of  $\alpha$ -methoxymesaconic acid and the  $\beta$ -half amide of  $\alpha$ -bromocitraconic acid and the corresponding imide are reported.

The infrared absorption spectra of a number of these adducts were investigated between 2 and 15 $\mu$  in order to obtain evidence concerning the presence or absence of certain carbonyl groups.

The structures of the  $\alpha$ ( $\beta$ ) substituted  $\alpha$ , $\beta$ -dicarboxylic acids studies are such that the formation of a planar configuration about this  $\alpha$ ( $\beta$ ) carbon atom is possible as is shown by the fact that inversion at this site may take place by intramolecular processes. Nevertheless it is found that the usual nucleophilic displacements do not occur. Instead either no reaction or anomalous reactions take place. It is therefore concluded that the steric hindrance inhibiting normal displacement is due to simple shielding and not to constrained bond angles. In regard to the general aspects of the substitution reaction, it is concluded that backside attack is required for nucleophilic displacement on carbon unless special forces, tending to promote carbonium ion formation (eg. extensive "B-strain") are present.

It is also shown that the loss of carbon dioxide and halide ion from  $\beta$ -halogen acids in basic media does not require an intermediate common to the  $\beta$ -lactone often simultaneously produced.

Microfilm copy of complete manuscript of 125 pages, \$1.56. Enlargements 6" x 8", 10¢ per page.

## THE REACTION OF CYANOGEN WITH ETHYLENEDIAMINE AND ITS ALKYL DERIVATIVES

(Publication No. 3426)

Russell Charles O'Gee, Ph.D.  
University of Buffalo, 1951

Cyanogen was reacted with ethylenediamine and propylenediamine without the use of a solvent and resulted in the formation of bis-( $\Delta$ <sup>2</sup>-2-imidazolinyl) and its 4,4'-dimethyl derivative. The structures of these white solids were determined by analysis and comparison with known samples of the compounds.

The reaction of cyanogen with buffered aqueous solutions of N-alkyl- and N,N'-dialkylethylenediamines resulted in the formation of sym-bis-(2-alkyl-aminoethyl)-oxamidines and N,N'-dialkyl, N,N'-bis-(2-alkylaminoethyl)-oxamidines respectively. The compounds prepared were those in which the alkyl group was C<sub>1</sub> through n-C<sub>4</sub> and were all viscous, fuming liquids. They were rather unstable and best preserved as the dipicrate derivatives. The proof of structures was based on analysis, hydrolysis, and comparison of the infrared absorption curves with those of known oxamidines.

Cyanogen reacted with ether solutions of N,N-dimethyl- and N,N-diethylethylenediamine to give solid compounds believed to be substituted cyanoformamidines. The analysis, molecular weights, and hydrolysis products indicated that they were N-(2,2-dialkylaminoethyl)-cyanoformamidines. The comparison of the infrared absorption curves with that for a cyanoformamide whose structure is known, however, showed a decreased absorption in the C≡N region and an increased absorption in the C≡N region for the new compounds. The structures of these compounds, therefore, are not definitely known and require further investigation.

The N-alkyl and N,N-dialkyl derivatives of ethylenediamine used in this work were prepared by the reaction of a primary or secondary amine with 2-bromoethylamine hydrobromide. This new synthesis was used to prepare N-methyl-, N-ethyl-, N-n-propyl-, N-i-propyl-, N-n-butyl-, and N,N-di-methylethylenediamine in yields of 32-53%.

Symmetrical disubstituted ethylenediamines were prepared by the method previously used in the preparation of N,N'-dimethylethylenediamine. This method consists of the addition of the alkyl amine to ethylenedibromide and was extended to include the di-ethyl-, di-n-propyl-, di-i-propyl-, and di-n-butyl-derivatives of ethylenediamine.

A new modification of the semi-micro Kjeldahl method for compounds containing nitro groups was used in the analysis of the picrate derivatives of the new compounds.

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**A STUDY OF SOME OPTICAL PROPERTIES  
OF CHLOROPHYLL SOLUTION**

(Publication No. 3090)

Victor Albert Ryan, Ph. D.  
University of Minnesota, 1951

The reversible phototropy of chlorophyll has been studied to ascertain the reaction kinetics of the reverse reaction for the case of chlorophyll b and to obtain the approximate spectrum of the product of illumination for both chlorophyll a and b.

A photometer was designed and constructed utilizing a photomultiplier as the sensing agent, interference filters to define the portion of the spectrum studied, and photographic multilamp tubes as actinic sources. The chlorophyll was scanned by a beam from a constant source which then struck the photomultiplier. The transient voltage appearing across the load resistor of the photomultiplier was amplified and displayed on an oscilloscope screen where it was photographed. The use of actinic light of a color not extensively passed by the interference filter used kept the direct illumination of the photomultiplier at a minimum. The photometer was calibrated in terms of the ratio of light transmitted at a given time to a standard transmitted intensity by the use of calibrated neutral density filters. Assuming the illuminated chlorophyll to contain only chlorophyll and one other colored substance a relation was deduced from Beer's law giving a quantity proportional to the concentration of the photo-product from the experimental data.

A calibration of the steady state photometer in terms of chlorophyll concentrations was made and using this and the values of the extinction coefficient of the photo-product determined later, it was found that nearly all the chlorophyll was converted to the photo-product at the peak of the flash. Using this fact an average second order rate constant of about  $3 \times 10^9$  liters per mole second was obtained. From earlier steady state observations of Livingston and McBrady one obtains a value of the quantum yield of  $1.5 \times 10^{-2}$  for the forward reaction using this rate constant.

Spectra of the product of illumination for both chlorophylls were obtained using a steady actinic source and noting the change in photomultiplier load current produced by turning this illumination on and off. From these measurements, using a calibration curve obtained with neutral density filters, ratios of the intensity transmitted to a standard intensity were obtained. If for a concentration,  $C_1$ , of chlorophyll of adsorption coefficient  $\alpha_1$  we write Beer's law, we have for the illuminated case  $\frac{I}{I_0} = e^{-(\bar{\alpha}_1 C_1 \ell + \bar{\alpha}_2 C_2 \ell)}$

and for the dark case  $\frac{I^\infty}{I^0} = e^{-(C_1 + C_2) \ell \bar{\alpha}_1}$

Dividing  $\frac{I^\infty}{I^0} = e^{\ell C_2 (\bar{\alpha}_1 - \bar{\alpha}_2)}$

$I^\infty$

It is assumed that for some wave length the absorption coefficient of the photo-product is nearly zero. This leads to a larger value of  $C_2$  from the

above equation than would be obtained at wave lengths where it is not zero. The largest value of  $C_2$  is then the one nearest the truth.  $\bar{\alpha}_1$  is obtained by graphical integration from the literature. Using the approximate value of  $C_2$  and  $\bar{\alpha}_1$  from the literature we can obtain the  $\bar{\alpha}_2$ 's. The ones we found were 50.8, 80.0, 24.4, 20.3, 13.5, 0.0, and 10.4 for wave lengths of 4030 Angstroms, 4395, 4680, 5020, 5245, 5880, and 6450 for chlorophyll a and 26.4, 59.8, 21.8, 0.0, and 7.6 for wave lengths of 4030 Angstroms, 4680, 5245, 5880, and 6450. They are defined by

$$\alpha = \frac{\log_{10} I_0/I}{C \times \ell} \quad \text{where } C \text{ is in grams per liter and } \ell$$

in centimeters.

At some wave lengths the absorption coefficient is greater than that of chlorophyll, at others it is less. The spectrum resembles that of the chlorophyll from which the photoproduct is derived; it also resembles that of the corresponding pheophytin.

Microfilm copy of complete manuscript of 108 pages, \$1.35. Enlargements 6" x 8", 10¢ per page.

**REDUCTION BY ALUMINUM  
IN AQUEOUS SOLUTION**

(Publication No. 3427)

Robert Donald Schwartz, Ph. D.  
University of Buffalo, 1951

After some preliminary and tentative experimental work, the application of aluminum, in powder form, was established as a promising line of work. The aluminum powder became the reducing agent, the electron donor, in the reduction of four oxidants. The oxidants used were iron (III), vanadium (V), molybdenum (VI), and tungsten (VI).

The chemistry of aluminum makes it a very valuable reducing agent. It has a very low equivalent weight, is amphoteric, and is available in several degrees of purity in various physical form. Aluminum dissolves to provide only one valence state, the colorless aluminum (III). This ion does not interfere with the subsequent determination of the other products of the reduction.

The major aim of this investigation was to study the reactions of aluminum with the four oxidants, and to explain the results obtained. A secondary aim was the establishment of volumetric methods for the determination of certain elements based upon reduction by aluminum.

It was found that certain anions that are not directly involved in the reaction of aluminum with the oxidants have a great effect on the overall result. In particular, chloride ion was found to favor the evolution of hydrogen rather than the reduction of iron (III) in acid solution. This effect was studied by measuring the efficiency of reduction of iron (III) by aluminum as the concentration of chloride ion was varied. As the concentration of chloride was increased, the efficiency of reduction of iron (III) decreased.

Chloride ion was important in another phase of the work. The oxidation of iron (II) by air was studied

at temperatures from 25° C to 100° C. As chloride ion was added to these solutions the amount of air oxidation increased. This was explained on the basis of the formation of the weak iron (III)-chloride complex. The formation of this weak complex, shifts the oxidation potential of the iron (II)-iron (III) system enough to cause the additional oxidation. This was considered important, because weak complex ions are not ordinarily of importance in analytical work.

The existence of the cations, of charge greater than one, as weak complexes of lower charge is of importance in the study of phenomena that depend upon the effective charge. It is suggested that deviations from the Schulze-Hardy rule may be explained by the formation of these weak complexes in solutions of highly charged cations.

Aluminum reduced solutions of vanadium (V) to vanadium (II). The metastable nature of vanadium (II) prevented the development of an accurate method of analysis. A rapid potentiometric method was found suitable for the study of the reduction of vanadium (V) and for the air oxidation of the vanadium (II). This method was also used in the work with molybdenum and tungsten.

Molybdenum (III) was produced by the action of aluminum on solutions of molybdenum (VI). This reaction was adapted to the analysis of molybdenum (VI) solutions. The blue solutions produced by the partial reduction of molybdenum (VI) were examined for colloidal behavior. The results of these tests, performed using a Tyndall beam, were that no colloidal phase exists in these materials.

Aluminum reduced tungsten (VI) to tungsten (IV) in acid solutions that contained phosphoric acid to prevent the precipitation of tungstic acid. Examination of acid solutions of tungsten (VI) with a Tyndall beam showed the absence of colloidal matter.

The reactions that were carried out using aluminum as the reducing agent, were explained on the basis of a direct transfer of electrons from the aluminum to the oxidant. No evidence that would support the "nascent hydrogen" theory of reduction was obtained. A search of the literature revealed that this theory was disproven by workers that used solvents containing no hydrogen. In the present research, the evolution of hydrogen, by the action of aluminum on the hydrogen ions present, was a side-reaction and not one that contributed to the reduction process.

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#### THE MECHANISM OF REINFORCEMENT V. THE ELECTRICAL CONDUCTIVITY OF CARBON BLACK LOADED ELASTOMER

(Publication No. 3429)

Robert R. Stromberg, Ph.D.  
University of Buffalo, 1951

An investigation of the electrical conductivity of carbon black loaded elastomer was undertaken in order to provide some insight into the mechanism of

filler reinforcement. The blacks used in this study were Vulcan-1 (Furnace black) and Spheron-6 (Channel black) and GR-S was used as the elastomer. The samples were, in general, compounded from master batches, cured in a hot platen press, and dried before any measurements were made. The measurements, whenever possible, were taken by means of recording Wheatstone bridges. The samples were annealed at 100° C. for 48 hours before being subjected to the conditions of the experiment. A number of interesting results were observed. A plot of the specific resistance in ohm-cms. versus carbon black loadings showed a sharp break in the curves for both blacks. The resistivity was found to depend upon the polarity and upon the applied D.C. voltage. Alternating current was also found to have an effect upon the D.C. resistance measurements in that the D.C. resistivity changed after A.C. had been applied for a short period of time. Stretching the samples usually produced an immediate increase in the resistance, which decreased with time if the sample was left in the stretched condition. Upon releasing the sample, the resistance increased again and then decreased with time. However, the resistance was observed to decrease when some of the samples were stretched. This was attributed to an anisotropic structure. A rapid decrease in temperature produced characteristic curves with both blacks although the curves were of a different nature. This decrease in temperature produced an immediate increase in the resistance of the Spheron-6 samples, which then decreased again at a slower rate. The equilibrium resistance at the lower temperature was higher than at the higher temperature. However, a decrease in temperature produced an immediate decrease in the resistance of the Vulcan-1 samples, which rose again very rapidly. It then dropped again, at first more rapidly, and then more slowly, until an equilibrium resistance was attained. In this case the equilibrium resistance was lower at the lower temperature than at the higher temperature. The difference in behavior of the two blacks was attributed to differences in the rates of adsorption of elastomer by the carbon black particles. The results were also interpreted to indicate that a definite structure must exist between the black and elastomer.

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#### X-RAY DIFFRACTION STUDIES OF CRYSTALLINE METHANOL

(Publication No. 3197)

Kenneth J. Tauer, Ph.D.  
University of Minnesota, 1951

The orthorhombic form of methanol has the space group  $D_{2h}^{17}$  - C<sub>mcm</sub>. There are four molecules in the unit cell which has the dimensions  $a = 6.43 \text{ \AA}$ ,  $b = 7.24 \text{ \AA}$ , and  $c = 4.67 \text{ \AA}$ . The crystal structure consists of infinite zig-zag chains of hydrogen bonds parallel to the (100) face. The C-O distance is 1.42  $\text{\AA}$

and the O—O hydrogen bond distance is 2.66 Å, indicating strong bonds of the order of 7.5 kcal/mole.

For a particular methyl, there are two methyls at 3.88 Å; four methyls at 4.01 Å; two oxygens at 3.86 Å and four oxygens at 4.09 Å. The large dielectric constant of the solid just below the melting point is discussed in terms of cooperative polarization of the hydrogen bonds and dipole orientation due to the large anisotropic temperature motion.

The diffraction effects obtained from single crystals cooled through the transition are presented and interpreted. The conclusion is reached that the transition at the lambda point is a simple displacive transformation involving a puckering of the molecules in the infinite hydrogen-bonded chains, but preserving the infinite chains of hydrogen bonds. This transformation reduced the symmetry to monoclinic, two molecules in the unit cell with  $a = 4.53$ ,  $b = 4.69$ ,  $c = 4.91$ ,  $\beta = 90^\circ$ . The space group is  $C_{2h}^2 - p\bar{2}_1/m$ . We

conclude that the residual entropy is zero, and that the dielectric anomaly is associated with the puckering of the chains discussed above.

Microfilm copy of complete manuscript of 45 pages, \$1.00. Enlargements 6" x 8", 10¢ per page.

#### PREPARATION AND REACTIONS OF $\alpha$ -CYANOALKYL BENZENESULFONATES

(Publication No. 3082)

Harry Willison Turner, Ph.D.  
University of Minnesota, 1951

In contrast to cyanohydrins, the chemistry of  $\alpha$ -cyanoalkyl benzenesulfonates has been singularly neglected. Only one such compound,  $\alpha$ -cyanobenzyl benzenesulfonate, has been reported and none of its chemical properties have been noted. Since this compound was prepared from readily available materials and since alkyl halides and alkyl benzenesulfonates are known to behave similarly towards many reagents, it was thought that  $\alpha$ -cyanoalkyl benzenesulfonates might be useful replacements, in many reactions, for the difficultly accessible  $\alpha$ -halonitriles. Consequently  $\alpha$ -cyanoalkyl benzenesulfonates, prepared by the method of Francis and Davis (J. Chem. Soc., 95, 1408 (1909)), were examined with respect to their reaction with three reagents: thiourea; a mixture of an aryl (alkyl) sulfonyl chloride with thiourea; and phenyl magnesium bromide.

The formation of 2,4-diamino-5-substituted-thiazoles from the interaction of  $\alpha$ -cyanoalkyl benzene-sulfonates and thiourea has been studied and found to be a general reaction limited only by the inactivity of the benzenesulfonyloxy group of some of the nitriles. This limitation was overcome by the addition of a molar quantity of sodium iodide to the reaction mixture. Thus  $\alpha$ -cyanobenzyl benzenesulfonate reacted directly and readily with thiourea to give the expected 2,4-diamino-5-phenylthiazole benzenesulfonate whereas  $\alpha$ -cyano- $\beta$ -phenylethyl benzenesulfonate and  $\alpha$ -cyano- $\gamma$ -phenyl-n-propyl benzenesulfonate reacted

with thiourea only after the addition of sodium iodide.

The structure of 2,4-diamino-5-phenylthiazole has been conclusively established by the preparation and analysis of derivatives and by acid hydrolysis to the known 2-amino-5-phenyl-4(5)-thiazolone. The structures of the other two diaminothiazoles, 2,4-diamino-5-benzylthiazole and 2,4-diamino-5-( $\beta$ -phenylethyl)-thiazole, have been assigned on the basis of 1) method of formation, 2) preparation and analysis of derivatives, 3) acid hydrolysis to compounds which have the correct empirical composition for 2-amino-5-benzyl-4(5)-thiazolone and 2-amino-5-( $\beta$ -phenylethyl)-4(5)-thiazolone respectively.

Any new thiazole synthesis is of interest because of the demonstrated value of thiazole compounds in industry (e.g., dye intermediates, rubber accelerators, therapeutics). The potential value of this diaminothiazole synthesis is enhanced by the fact that it supplies a simple route to a hitherto little studied class of compounds, one member of which, 2,4-diamino-5-phenylthiazole, has recently been reported (Davies, MacLaren and Wilkinson, J. Chem. Soc., 3491 (1950)) to be a potent analeptic.

Troger (J. prakt. Chem., (2) 71, 201 (1905)) has prepared many  $\alpha$ -sulfonylacetonitriles by the interaction of chloroacetonitrile and the alkali salt of sulfinic acids. We have prepared  $\alpha$ -cyanobenzyl aryl (alkyl) sulfones by the reaction of  $\alpha$ -cyanobenzyl benzenesulfonate with a mixture of an aryl (alkyl) sulfonyl chloride and thiourea. This mixture has been shown to be equivalent to a salt of the corresponding aryl (alkyl) sulfinic acid. The structures of the  $\alpha$ -cyanobenzyl aryl (alkyl) sulfones have been established by their conversion, by alkaline hydrolysis, to known benzyl aryl (alkyl) sulfones. Treatment of an acetic acid solution of an  $\alpha$ -cyanobenzyl aryl (alkyl) sulfone with calcium hypochlorite has given an excellent yield of the corresponding  $\alpha$ -chloro- $\alpha$ -cyanobenzyl aryl (alkyl) sulfone. The action of sodium hypobromite on an alkaline solution of an  $\alpha$ -cyanobenzyl aryl (alkyl) sulfone has yielded, in general, the corresponding  $\alpha$ -bromo derivative. An attempt to prepare  $\alpha$ -bromo- $\alpha$ -cyanobenzyl benzyl sulfone by this route, however, yielded only  $\alpha$ -cyanostilbene. This same compound,  $\alpha$ -cyanostilbene, was also formed when  $\alpha$ -chloro- $\alpha$ -cyanobenzyl benzyl sulfone was treated with alkali. A mechanism has been formulated for this alkali-catalyzed rearrangement of  $\alpha$ -halosulfones.

The reaction of  $\alpha$ -halonitriles with Grignard reagents has been reported to give complex mixtures from which, in general, only one or two components could be separated. The action of phenyl magnesium bromide on  $\alpha$ -cyanobenzyl benzenesulfonate and on  $\alpha$ -cyano- $\gamma$ -phenyl-n-propyl benzenesulfonate has also yielded mixtures. From  $\alpha$ -cyanobenzyl benzene-sulfonate there was obtained two compounds in small amount which had the empirical compositions  $C_{22}H_{19}O$  (m.p. 162.0-162.5°) and  $C_{26}H_{25}O_4NS$  (m.p. 263-265; dec.). The latter compound when triturated with an alkaline solution was converted into a new compound, m.p. 153-154. Treatment of a suspension of this new compound in dilute hydrochloric acid with a solution of sodium nitrite resulted in the formation

of phenyldeoxybenzoin. From  $\alpha$ -cyano- $\gamma$ -phenyl-n-propyl benzenesulfonate there was obtained one compound (m.p. 190-191°) in low yield which had the empirical composition C<sub>28</sub>H<sub>27</sub>O<sub>3</sub>NS. Acetic anhydride reacted with this compound to form a substance C<sub>30</sub>H<sub>29</sub>O<sub>4</sub>NS (m.p. 208.5-209.5°). None of these Grignard products were completely characterized.

Microfilm copy of complete manuscript of 110 pages, \$1.38. Enlargements 6" x 8", 10¢ per page.

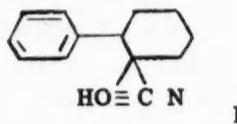
### 6-PHENYL- $\Delta^1$ -CYCLOHEXENYL-1-CARBONITRILE

(Publication No. 3094)

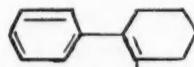
Alexander Zuckerbraun, Ph.D.  
University of Minnesota, 1951

Boekelheide and Schilling (J.A.C.S., 72, 712 (1950)) effected the dehydration of 2-phenylcyclohexanone cyanohydrin (I) with thionyl chloride and pyridine and reported the major product to be 2-phenyl- $\Delta^1$ -cyclohexenyl-1-carbonitrile (II). No mention was made of the possible formation of isomeric compounds and no proof of structure was furnished. The purpose of this investigation was to study the structure of the major product obtained by the dehydration of I and to study the action of Grignard reagents on the product.

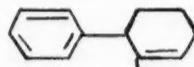
This author demonstrated by application of ultraviolet absorption analysis and degradation studies that the principle product previously reported by Boekelheide to be 2-phenyl- $\Delta^1$ -cyclohexenyl-1-carbonitrile (II) was 6-phenyl- $\Delta^1$ -cyclohexenyl-1-carbonitrile (III).



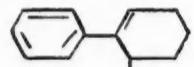
I



II

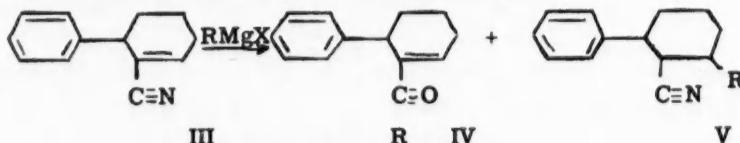


III



C≡N

6-Phenyl- $\Delta^1$ -cyclohexenyl-1-carbonitrile (III) was treated with the Grignard reagent prepared from methyl bromide, ethyl bromide, benzyl chloride, and bromobenzene. The results indicate that no isomerization of the double bond occurred and that normal 1,2- and 1,4- products were formed.



The results are summarized in the chart below:

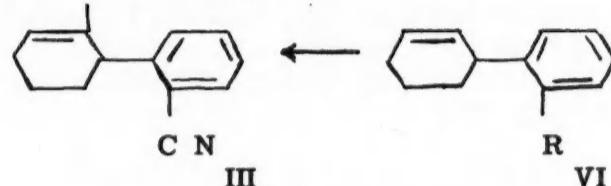
Grignard reagent	% 1,2-addition*	% 1,4-addition*
CH <sub>3</sub> MgBr	100	---
CH <sub>3</sub> CH <sub>2</sub> MgBr	98	2
ØCH <sub>2</sub> MgCl	---	100
ØMgBr	100	---

\* per cent of type of addition from the isolated product.

Ultraviolet absorption analyses on the ketone (IV) and their 2,4-dinitrophenylhydrazones demonstrated that the double bond was conjugated with the carbonyl group and not with both the phenyl and carbonyl groups. Infrared absorptions further indicated that the ketones possessed  $\alpha$ , $\beta$ -unsaturation.

Structure V was proposed for the 1,4-addition products obtained from the ethyl and benzyl Grignard reagents.

Three derivatives, the acid (VI,a), the amide (VI,b) and the methyl ester (VI,c) were prepared from the unsaturated nitrile (III) and it was demonstrated by the use of ultraviolet absorption analyses that no migration of the double bond occurred during the formation of these compounds.



a, R=COOH  
b, R=CONH<sub>2</sub>  
c, R=COOCH<sub>3</sub>

To show that the carbon skeleton remained unchanged throughout these transformations, the acid (VI,a) was reduced with Raney's nickel-aluminum alloy and sodium hydroxide to give *trans*-2-phenylcyclohexane-1-carboxylic acid. Its identity was confirmed by a mixed melting point with an authentic sample.

Microfilm copy of complete manuscript of 149 pages, \$1.86. Enlargements 6" x 8", 10¢ per page.

### CHEMISTRY, PHARMACEUTICAL

#### A PHYTOCHEMICAL STUDY OF AMBROSIA MARITIMA LINNE

(Publication No. 3202)

Hamed A. Abu-Shady, Ph.D.  
University of Minnesota, 1951

Ambrosia maritima L. (fam Compositae) is an annual herbaceous plant. The phytochemical investigation of the flowering tops of this plant revealed the presence of two crystalline principles to which the names damsin and ambrosin were suggested.

Damsin, C<sub>15</sub>H<sub>20</sub>O<sub>3</sub>; [α]<sub>D</sub> 22 = -29.1° was obtained

in colorless prisms, melting point 107°. It dissolves in most organic solvents, but was found to be sparingly soluble in water and dilute acids. Damsin, however, dissolved slowly in dilute alkali solution upon warming, and crude damsins was recovered on acidification of the alkaline solution. Damsin formed a 2:4-dinitrophenylhydrazone. Catalytic hydrogenation in the presence of five per cent palladium on charcoal reduced damsins to two isomeric dihydro forms: C<sub>15</sub>H<sub>22</sub>O<sub>3</sub>, namely  $\alpha$ -dihydrodamsin and  $\beta$ -dihydrodamsin.

$\alpha$ -Dihydrodamsin formed an oxime and a 2:4-dinitrophenylhydrazone. Although damsins analysed for one C-methyl group, both  $\alpha$  and  $\beta$ -dihydrodamsins analyzed for two C-methyl groups. Both  $\alpha$  and  $\beta$ -dihydrodamsins formed, under identical conditions, monobromo derivatives,  $C_{15}H_{21}O_3Br$ , that were different. Oxidation of  $\alpha$ -dihydrodamsin with nitric acid gave rise to a carbonyl free dicarboxylic acid,  $\alpha$ -damsinic acid,  $C_{13}H_{18}O_5$ . The dimethyl ester of  $\alpha$ -damsinic acid,  $C_{15}H_{22}O_5$ , was prepared by the action of diazomethane on  $\alpha$ -damsinic acid.  $\alpha$ -Dihydrodamsin gave rise to an oily fragrant desoxy compound when subjected to Clemmensen reduction. Catalytic hydrogenation in presence of Adams platinum oxide catalyst reduced damsins to a tetrahydromamsin which formed a crystalline 3:5-dinitrobenzoate. Bromination of damsins gave rise to only one bromine containing compound. Although the analysis of this bromo derivative did not account for any acceptable formula, it pointed towards the presence of three bromine atoms in the molecule. Condensation of damsins with piperonal, a) in presence of hydrogen chloride; b) in presence of sodium hydroxide, was effected. In each case a crystalline derivative was obtained, but their analyses were different and uninterpretable. Reduction of damsins with lithium aluminum hydride gave no crystalline material, but gave an oily substance which neither yielded a crystalline acetate nor a crystalline 3:5-dinitrobenzoate.

Ambrosin, on the other hand, was found to occur in bitter prismatic crystals,  $[\alpha]_{D}^{22} = -154.5^{\circ}$ , melt-

ing point  $150^{\circ}$ . It was soluble in most organic solvents, insoluble in dilute cold alkali solution, but gradually dissolved in five per cent sodium hydroxide solution on warming. A tentative formula of  $C_{17}H_{22}O_4$  was proposed for the compound. Ambrosin failed to yield a crystalline derivative when reacted upon with hydroxyl amine; p-nitrophenylhydrazine, 2:4 dinitrophenylhydrazine, though the reaction in each case seemed to proceed.

Microfilm copy of complete manuscript of 62 pages, \$1.00. Enlargements 6" x 8", 10¢ per page.

#### ESTERS AND AMIDES OF SUBSTITUTED $\beta$ -AMINO ACIDS AS POTENTIAL ERGOT SUBSTITUTES

(Publication No. 3542)

Paul Edmund Norris, Ph.D.  
University of Michigan, 1952

Ergot has been used in medicine for many years as an oxytocic drug. Of the six pharmacologically active alkaloids which are found in ergot, the most important, clinically, is ergonovine. The high cost, the uncertainties of an agricultural source and the low yields of the alkaloids are disadvantages which make it desirable to discover a synthetic substitute for ergot or, particularly, for ergonovine which is one of its constituents. All of the ergot alkaloids are substituted amides of lysergic acid; ergonovine, the

2-(1-hydroxy)-propylamide, is the simplest of these alkaloids.

The purpose of this investigation was to synthesize amides and also esters of compounds which represent fragments of the lysergic acid molecule. It was hoped that some of these products might possess oxytocic activity. Lysergic acid is a tetracyclic system which contains a tetrahydropyridine-3-carboxylic acid condensed with benz(cd)indole. Because of its ease of preparation, 1-methylnipecotic acid was used as a modified, or fully saturated, representative of the 1-methyltetrahydropyridine-3-carboxylic acid portion of lysergic acid. The 2-aminopropyl and 2-amino-butyl esters of 1-methylnipecotic acid were prepared but their hydrobromides could not be purified. The free bases of these esters slowly isomerized to the corresponding alcohol amides; the 2-(1-hydroxy)-butylamide of 1-methylnipecotic acid was obtained in a pure form.  $\beta$ -Diethylaminoethyl 1-methylnipecotate was prepared as well as its dihydrochloride and dimethobromide. These products did not exhibit a significant oxytocic activity.

An attempt was made to synthesize 1-methyl-6-skatylnipecotic acid by a five step synthesis from N-methyltryptophan. Unfortunately, the only published synthesis for the latter substance is very unsatisfactory for its preparation in large quantities. A number of unsuccessful attempts were made to find a short simple synthesis for N-methyltryptophan. Endeavors to use N-methyltryptophan for the preparation of 1-methyl-6-skatylnipecotic acid were unsuccessful.

Esters and amides of three derivatives of  $\beta$ -alanine which represent portions of the lysergic acid molecule were prepared. These compounds are, N-methyl-N-[ $\beta$ -(3-indolyl)-ethyl]- $\beta$ -alanine methyl ester hydrobromide (I), N-methyl-N-[ $\beta$ -(3-indolyl)-ethyl]- $\beta$ -alanine diethylamide oxalate (II), N-methyl-N-( $\beta$ '-phenylethyl)- $\beta$ -alanine diethylamide hydrobromide (III), and N-methyl- $\alpha$ -benzyl- $\beta$ -alanine ethyl ester hydrochloride (IV). Compounds I, II and III were prepared by the addition of N-methyltryptamine or N-methyl- $\beta$ -phenylethylamine to methyl acrylate or to N,N-diethylacrylamide. Compound II was purified by chromatography with an alumina column. Compound IV was obtained in poor yield from benzylmalonic ester, formaldehyde and methylamine by the use of the Mannich reaction, followed by hydrolysis and decarboxylation.

The  $\beta$ -alanine derivatives were found to be stable as salts for a period of several months. When kept for six months or more the salts developed an acrylate odor, evidently due to decomposition of the compound into an amine salt and an  $\alpha$ , $\beta$ -unsaturated compound.

A small degree of oxytocic activity was exhibited by N-methyl-N-[ $\beta$ -(3-indolyl)-ethyl]- $\beta$ -alanine diethylamide oxalate. None of the other derivatives which were prepared possessed a significant oxytocic action.

Microfilm copy of complete manuscript of 128 pages, \$1.60. Enlargements 6" x 8", 10¢ per page.

## DRAMA

**AMERICAN DRAMA 1782-1812 AS AN INDEX  
TO SOCIO-POLITICAL THOUGHT**

(Publication No. 3444)

Josef Aaron Elfenbein, Ph.D.  
New York University, 1951

## Problem

The study of American drama is relatively an unexplored field. Investigations to date have been extremely limited in number and in general cover large periods of theatrical development in single reports. As a result of this situation, the student of American drama finds nowhere a detailed and comprehensive, analytical and comparative study revealing the position of the early American dramatist as a reflective agent of socio-political thinking of his day. With the intent of contributing to this area, this research was undertaken to provide an analysis of all available early American drama, 1782-1812, as an index to socio-political thought. The period selected for examination extends from 1782, with the signing of the treaties confirming the independence of the new republic, to 1812 with the outbreak of the new war.

## Procedure

This study required a comparison of socio-political problems facing the American of 1782-1812, as ranked in order of importance by present social science authorities, with the problems presented in order of importance by the dramatists of the same period. Eighteen social science authorities provided the problems and the ranking, as well as approval for the reference material used in the study of the historical section of the investigation. One hundred and forty-nine plays published or performed during the period from 1782-1812 were examined for pertinent drama material. This mass of dramatic literature represents almost all available drama within the limitations of the period and required the resources of The Library of Congress, the New York Public Library, the H. E. Huntington Library, the Boston Public Library and the libraries at Columbia University, Harvard University, New York University, the University of Chicago, the University of Iowa and the University of Pennsylvania. In addition to this primary source material, reference was made to previous investigations important to the entire study.

The study was divided into chapters according to: the plan of the dissertation, the socio-political problems of the period, the history of the American drama from the beginnings through 1812, each major issue reflected in the drama, and the conclusions derived from the study.

## Results

The results of this research can be summarized briefly as follows: Since the American dramatists are in substantial accord with the social science authorities, the early American drama is largely a valid source for the study of socio-political conditions in post-Revolutionary War America. With the single exception of the majority of dramatists' interest in

slave abolition and religion, the playwrights indicate a faithful reflection of the America in which they lived. While the literary merit of the drama is indisputably inferior, the social and political implications are outstanding as contributions to an understanding of the period. Forced to a portrayal of national events by severe competition from abroad, the American dramatists of 1782-1812 created documents of historical worth that cannot be ignored.

Microfilm copy of complete manuscript of 375 pages, \$4.69. Enlargements 6" x 8", 10¢ per page.

## ECONOMICS

**AN ECONOMIC ANALYSIS OF THE SHIFT FROM  
CREAM TO WHOLE MILK IN MINNESOTA  
COOPERATIVE CREAMERIES**

(Publication No. 3203)

John Thomas Buck, Ph.D.  
University of Minnesota, 1951

This study analyzes the shift in local Minnesota cooperative creameries from receiving their raw material as cream to whole milk in response to changed demands associated with World War II. Before the war whole milk deliveries represented only 10 per cent of the total milk production in the state while in 1946 they amounted to 53 per cent of the total.

A sample including 175 cooperative creameries for which data had been assembled over a period of years was used in this study. This sample had been selected to provide representation of the various areas of the state.

The extent of this shift to whole milk deliveries varied among different areas with the more intensive dairy areas in southeastern, south central, and east central Minnesota shifting largely to whole milk deliveries. Type of farming, type and number of livestock consuming skim milk, and the favorableness of the market outlook were some factors determining the extent of the shift.

Creameries with a large volume of output were among the first to shift to whole milk operation and were able to maintain or increase their volume of operation after the shift to whole milk. In the sample of 175 cooperative creameries studied, those creameries which did not equip their plants to handle whole milk in addition to farm-separated cream lost volume while those that started whole milk operation gained volume. Increased use of trucks in the assembly of butterfat and a larger supply area came about with the shift to milk.

Large investments in new equipment for handling whole milk in local creameries and in central drying plants were made by those creameries which shifted to whole milk operation. Increased borrowing was necessary to meet these capital needs. This resulted in a relatively less favorable net worth position for those creameries that shifted to milk. Working capital suffered.

Changed plant operating conditions resulted in increased operating costs. Per unit costs of handling each pound of butterfat under various operating conditions were calculated for the sample plants studied. Costs in 50 cream creameries averaged 4.979 cents per pound of butterfat handled or approximately .6 of a cent less than that of the whole milk creameries. The handling of a larger proportion of whole milk increased costs. Costs were also higher where the milk was used in butter manufacture rather than being sold wholesale to other dairy plants.

Multiple correlation analysis showed a significant degree of association between the volume of butterfat handled, the proportion of butterfat handled as whole milk, the proportion of butterfat utilized in the various uses and total operating costs.

Net available proceeds per pound of butterfat handled in 1947 were about 7 cents higher for whole milk creameries than for those handling farm-separated cream only. Total operating costs and the proportion of milk utilized in various uses were found to be associated with the average net returns available per pound of butterfat handled.

Less butterfat was used in butter manufacture as the shift was made to whole milk operation. Retail milk and cream and wholesale sales of milk and cream to other plants increased tremendously. About three-fifths of the milk butterfat of creameries in whole milk operation was churned with one-half of the butter made coming from butterfat bought in whole milk.

Dry skim milk products hold the key to the continuance of whole milk operation. Some expansion in fluid milk and cream and in cheese may occur. Regardless of the economic outlook, whole milk creameries handling a large volume of butterfat are likely to continue to operate efficiently in the industry. Control of internal plant costs and good business management will be needed in all plants.

Microfilm copy of complete manuscript of 371 pages, \$4.64. Enlargements 6" x 8", 10¢ per page.

#### A SURVEY OF THE THEORY AND TECHNIQUE OF RAILROAD TAXATION IN THE UNITED STATES

(Publication No. 2934)

Albert Carl Dambrun, Ph.D.  
Princeton University, 1941

Abstract not available.

Microfilm copy of complete manuscript of 268 pages, \$3.35. Enlargements 6" x 8", 10¢ per page.

#### FINANCING THE HIGHWAY FUNCTION IN ST. LOUIS COUNTY: A CASE STUDY IN THE FINANCIAL PRACTICE OF GOVERNMENT AT MID-CENTURY

(Publication No. 3503)

Howard Strauss Gordman, Ph.D.  
University of Michigan, 1952

The objectives of this study are to determine the actual financial support of the highway function of government in St. Louis County at mid-century and to appraise the distribution of that support between the major sources of revenue (motor vehicles and property) and among the participating layers of government (state, county, and municipal) in the light of relevant aspects of the theory of highway finance.

The relationship found between the actual and ideal distributions of highway financial responsibility is important because knowledge of this relationship is fundamental to any sensible revision of highway taxation.

The study is divided into three parts to treat: first, the existing highway economy and its financial support; secondly, highway financial theory and some of its ramifications; and, thirdly, the equity of actual highway financial responsibility.

Part One explains the nature of the County's economy; describes the economy's basic physical framework — its highways; indicates their role and contributions to the economy; distributes responsibility for these highways functionally to the highway plants of the governmental units providing highway service; and, finally, analyzes the sources of the highway funds sustaining those plants and the uses to which these funds are put. This analysis, which is carried back to 1917 origins, is focussed on 1950.

Part Two in turn considers the fee principle in relation to the highway benefit district idea; analyzes the concepts and composition of highway costs; surveys theories of their distribution among highway beneficiaries (vehicle-users, owners of abutting properties, and the general public); reconnoiters ideas on the apportionment among vehicle classes of the share of highway costs chargeable to vehicle-users as a group; investigates highway problems within each layer of government; analyzes inter-governmental highway relationships; and takes into consideration several special situations presented by other factors in highway affairs, such as railroad crossings and non-vehicular uses of highways.

Part Three sets up the results of thirteen authoritative studies on the assignment of highway financial responsibility and makes a weighted application of these to the overall plant under consideration. This is accomplished by multiplying the percentage assignment of motor vehicle tax revenues to each highway system by two corresponding factors, namely vehicle-user imposts as a percentage of all revenues of each plant and all revenues of each plant as a percentage of all revenues of all plants. On this basis, it then becomes possible to attempt an evaluation of the distribution of the actual financial support of the highway function of government in St. Louis County at 1950.

The results indicate a rather small and strikingly small vehicular responsibility respectively for the overall and county plants and a moderately large vehicular responsibility for the municipal plant. State plant responsibility is approximately normal.

Conclusions following are: one, that vehicular impost support of the overall plant should be increased; two, that property tax support of the county road plant and vehicular impost support of the municipal street plant should be reduced; and, three, that local vehicular imposts should generally be unified into a gallonage tax levied less arbitrarily.

Microfilm copy of complete manuscript of 351 pages, \$4.39. Enlargements 6" x 8", 10¢ per page.

**A STATISTICAL ANALYSIS OF EATING PLACES AS MARKETERS OF FOOD PRODUCTS IN MINNEAPOLIS AND FAIRMONT, MINNESOTA, AND IN THE UNITED STATES**

(Publication No. 3206)

Lester Clayton Sartorius, Ph.D.  
University of Minnesota, 1951

This pilot study of the division of the total market for food into two distinct sectors (home and away-from home), and of the characteristics of food marketing and consumption in the away-from home sector, is based on random sample data on the characteristics of the Minneapolis industry, existing Census data, and selected case studies in every major type of eating place in Minneapolis and Fairmont. The development of topics and efficient procedures for further research was a major objective.

Minneapolis contained 1,553 establishments serving prepared meals valued at about \$ 54,000,000 in 1948. Six major groups of commercial public eating places in Minneapolis realized about 81 per cent of total meal sales, and five major groups of private eating places accounted for the remaining 19 per cent. There is considerable concentration of sales in the larger places.

Fairmont, a city of 8,000 population, contained 34 establishments serving prepared meals valued at \$ 769,000 in 1948. All types of commercial eating places found in Minneapolis were represented in Fairmont except for the cafeterias. However, there were no eating places of the private type in Fairmont in 1948 other than the hospital.

The proportions of the value of the total food supply in the three areas that were marketed through eating places in 1948 were estimated at 15 per cent for the United States, 16 per cent for Fairmont, and 18 per cent for Minneapolis. Two other measures of the relative importance of the eating place industry were also derived and discussed.

Eating places add many more services and facilities to purchased food than retail food stores add to their purchased food, and eating places therefore need much wider margins for marketing comparable physical quantities of food. Eighteen Minneapolis eating places had gross food cost percentages in 1949 of 33 to 52 per cent of sales, and a weighted average food cost estimated at 43.7 per cent. Twelve Fairmont eating places had gross food costs in 1949 of from 40

to 66 per cent of sales, and a weighted average food cost estimated at 53.2 per cent. The above weighted average food costs amount to average markups on costs of 129 and 86 per cent. These markups are 7 and 4-1/2 times as large as the average markup of 19 per cent for selected food stores.

The study of five types of Minneapolis eating places indicate per person quantitative food consumption rates for meat, fish, and poultry that were more than twice as high in high priced cafes and hotels as in a sample of Minneapolis-St. Paul families and in the United States as a whole, but meat, fish, and poultry consumption rates in moderate priced eating places were roughly similar to the Minneapolis-St. Paul family and the national consumption rates. Eating place consumption rates for fruits and refined sugar were generally smaller, and consumption rates for fats and oils, potatoes, and coffee were generally higher than in Twin City families and in the nation. Food consumption rates for milk products, eggs, vegetables, and grain products varied considerably by types of eating place, both above and below the Minneapolis-St. Paul family and the national rates.

The study of food value purchase patterns show that selected Minneapolis and Fairmont eating places spent appreciably larger percentages of their food purchase dollar on the meat, fish, and poultry food group than average food store purchasers.

The broad conclusion to be drawn from this pilot study is that eating places are important distributors of food products performing desired but costly services, and that because of their special characteristics, specific cognizance must be given to their role when analyzing the total market for, and consumption of, food.

Microfilm copy of complete manuscript of 199 pages, \$2.49. Enlargements 6" x 8", 10¢ per page.

**'THE SECURITIES ACT OF 1933  
AN ANALYSIS OF ITS BACKGROUND,  
ADMINISTRATION, AND EFFECTS**

(Publication No. 3065)

Edward F. Willett, Ph.D.  
Princeton University, 1939

Abstract not available.

Microfilm copy of complete manuscript of 550 pages, \$6.88. Enlargements 6" x 8", 10¢ per page.

**THE DEVELOPMENT AND USE OF THE MARKET CONCEPT IN VALUE ANALYSIS**

(Publication No. 3068)

Nathaniel Wollman, Ph.D.  
Princeton University, 1940

Abstract not available.

Microfilm copy of complete manuscript of 279 pages, \$3.49. Enlargements 6" x 8", 10¢ per page.

**EDUCATION****AN EVALUATIVE STUDY OF A STATE'S  
CENTRAL EDUCATION AGENCY  
AN APPRAISAL OF ITS PURPOSE,  
STRUCTURAL ORGANIZATION,  
AND FUNCTIONING**

(Publication No. 3438)

Arnold DeWald Albright, Ph.D.  
New York University, 1951

During recent years, a mounting concern for more functional state administration in education has been evident. This concern has focused upon the role which the states' central education agencies should play in a total program of education and how that role can most appropriately be fulfilled.

The aim of this study became that of assisting in the clarification of this concern and in the development of suggested procedures by which such clarification might be effected. The two-fold purpose of the investigation was (1) to identify from a philosophical mooring principles which would serve as criteria for an appraisal of the purpose, structural organization, and functioning of a state's central education agency; and, (2) to demonstrate the use of the criteria by their application in an appraisal of the three factors in Tennessee's central education agency.

The philosophical mooring embodied in "integrated concensus of representative thinkers" who were identified with pragmatic conceptual theory and included conceptions and interpretations held by the investigator. Values were identified through a reflective process in three classifications: Democracy as a pattern of "associated living," the "scientific method" as an appropriate means in education for implementing the pattern, and the nature of human growth and development basic to the means and the pattern. These principles were extended into basic functions of state educational administration, related to the three factors to be appraised, and formulated in question form as criteria.

Through the use of the historical method, the emergence of the purpose, structural organization, and functioning of Tennessee's central education agency was analyzed and described for the period of 1796 to 1950 in terms of activities and services. The current emergents in the activities and services which reflected the nature of the three factors were determined through data gathered from local educational personnel and from the personnel and records of Tennessee's state department of education. The data supplied by local educational personnel were obtained from a representative sampling in thirty-three local systems through the use of a questionnaire. This instrument called for "free" responses concerning services received, how the services were provided, and judgments of their value. The personnel of the Tennessee state department of education furnished data on their activities through the completion of "activities

analyses" which described duties and responsibilities, amount of emphasis on each activity, persons involved, and the flow of results.

The evaluation step in the study involved the process of matching the principal characteristics found in the evidence concerning the three factors and the elements of the criteria. The outcomes of this process were expressed under three categories as inferential statements of the extent to which the criteria were satisfied in the data.

The positive features found included the trend in the purpose of Tennessee's agency to assist local educational personnel in cooperative planning on problems of mutual concern. The strengths of the agency's structural organization lay in the existence of a state board of education, a chief state education officer, and a state department of education. The use of problem-solving processes in internal operation and in in-service education in the field was a strength in agency functioning.

Limitations included the confinement of cooperative planning to in-service education projects, the method of constituting the state board of education and selecting the chief state education officer, and a paucity of coordination of available services.

Weaknesses included a dichotomy in purpose, an organization of non-functional divisional units, and a reliance upon authoritative procedures in operation.

Recommendations included procedural steps for developing a unified purpose, arranging a two-divisional state department of education and a single policy-making state board, and functioning on a cooperative problem-solving basis.

Similar studies were suggested using other states as cases for appraisal. Suggested inquiries included other factors of state educational administration.

Microfilm copy of complete manuscript of 289 pages, \$3.61. Enlargements 6" x 8", 10¢ per page.

**A STUDY OF SELECTED COMPETENCIES  
OF PROSPECTIVE TEACHERS IN ALABAMA**

(Publication No. 3461)

Reva White Allman, Ph.D.  
University of Michigan, 1952

This investigation was designed to ascertain how potential teachers in Alabama Negro Colleges measure in selected competencies desired of teachers. The selected competencies were: (1) intelligence, (2) subject matter to be taught, and (3) general knowledge. Other related questions evolving from the primary issue were: (1) what is the difference in achievement between junior high school pupils and prospective teachers, (2) what institutional differences can be found in the achievement of college students, (3) what is the achievement of students on the basis of the number of years of college experience, (4) what is the achievement of prospective teachers as compared with the

non-teaching group, and (5) what positive relationship exists between the various measures.

Two groups of students were included in the investigation, namely, college students and eighth grade pupils. The first samples of college students were taken in 1945. This group included 397 students representing four colleges. The second samples were procured in 1951. The second samples consisted of 71 seniors from the teachers college and the entire senior class of 88 students from the liberal arts college. In the eighth grade group, there were 457 subjects. These pupils were all of the available Negro pupils enrolled in the eighth grades of the Birmingham Public Schools.

The following tests were employed: (1) The Otis Quick-Scoring Mental Ability Tests, Forms Beta and Gamma, (2) The Stanford Achievement Test, Advanced Battery, Form D, (3) The Schorling, Clark and Potter, Hundred-Problem Arithmetic Test, Form W, (4) The Cooperative Reading Comprehension Test of the American Council of Education, Form S. CI, Lower Level, and (5) The Sims Score Card for Socio-Economic Status.

The findings disclosed that in mental ability the teachers attained a low average rating. When the teachers were compared with the junior high school pupils, they were found to have scored slightly higher than the pupils. The reading performance of the teachers placed them between the eighth and ninth grade norms established for southern secondary schools. The reading achievement of the teachers in both samples differed significantly from the achievement of the pupils. The average scores for teachers on the Hundred-Problem Arithmetic Test were equivalent to the seventh grade norm. The junior high school pupils scored considerably below the seventh grade norm. The average achievement of the teachers on the Stanford Achievement Battery placed them above the ninth grade norm. The pupils reached the sixth grade level of performance on this test.

An investigation of the related questions revealed that institutional differences in achievement were found to exist in the various colleges studied. Also, significant differences were found between the achievement of the three upper classes and the freshman class, but not between the upper classes themselves. The teachers as a group made better scores than the non-teachers on all of the tests except reading. Significant differences were found to exist between the achievement of teachers and non-teachers at the 1 percent level of confidence. In general, high positive correlations were found to exist for the data collected. One negative coefficient of correlation was found when the relationship between the socio-economic scores and subject-matter achievement was studied for the teachers group.

The following statements are only representative of the complete findings and conclusions of this investigation:

1. There is substantial agreement that teachers should possess a high degree of proficiency in many areas.

2. It is very doubtful whether the subjects in this study have attained the competencies desired of teachers.

3. There is evidence that the eighth grade pupils of Birmingham are achieving at a low level.

4. Institutional differences are found to exist in the achievement of college students.

5. In the higher institutions studied there is no validity to the assertion that those preparing for the teaching profession are not as competent as students preparing for other professions.

Microfilm copy of complete manuscript of 162 pages, \$2.03. Enlargements 6" x 8", 10¢ per page.

#### THE DEVELOPMENT OF STANDARDS IN STUDENT TEACHING IN PHYSICAL EDUCATION FOR THE TEACHER EDUCATION PROGRAMS OF NEW JERSEY

(Publication No. 3439)

Virginia Whittier Ames, Ed. D.  
New York University, 1951

A study of the program for professional preparation of physical education teachers was undertaken for the purpose of establishing standards for the student teaching phase of this program in the five teacher preparation institutions of New Jersey offering a major in physical education. These colleges are New Jersey College for Women, New Jersey State Teachers College at Trenton, Panzer College of Physical Education and Hygiene, School of Education, Rutgers University, and Seton Hall College.

Curriculum patterns, professional laboratory experience, supervisory practices and evaluation are four areas concerned with student teaching. It was felt that variation within these areas existed and that it was desirable to establish standards and recommend their adoption.

A survey of literature revealed that little direct research on the student teaching phase of teacher preparation has been made and that no standards for the student teaching program in physical education existed.

Data for this State study were gathered from state, district and national courses. A projected plan was reviewed by the Assistant Commissioner in charge of Higher Education, State Department of Education, Trenton, New Jersey. Assured of his support the plan was launched in the five institutions of New Jersey concerned with professional preparation in physical education. Data were obtained through personal conference with the head of each major department. The curricula for the nine year period, 1940 to 1949 were reviewed. Personal interviews with principals and supervising teachers of cooperating schools and with student teachers who had completed responsible student teaching were conducted to determine practices and local and state influences. State certification requirements were studied.

A questionnaire survey of forty-four institutions in the Eastern District Association of the American Association for Health, Physical Education and Recreation was conducted in order to determine existing practices and operative standards.

A review of literature on general teacher education and physical education was made to determine the nature and direction of trends in teacher education and specifically in student teaching.

Analysis of yearly curricula offerings of each New Jersey institution was made by tabulating courses and semester hours under the headings: (1) academic courses required by the institution, (2) foundation science courses, (3) required courses in professional education, and (4) courses required in health and physical education. Tables were constructed to show information yielded from personal interviews. The data from the Eastern District survey were recorded in tables with percentages computed for each item. National trends and standards were analyzed for common elements of agreement.

It was discovered that two types of curriculum pattern were used, the professional sequence type and the four year general and professional program of teacher education. A lack of definite practice for laboratory experience prior to student teaching was revealed, but there was a uniform tendency in all colleges to allot large blocks of time to student teaching. There was little uniformity in the type of program the colleges required. Consideration of the individual's interests, his ability to take additional responsibility and his need for a wide range of experience seldom resulted in modification of his program. Attempts to extend professional laboratory experience beyond the responsible student teaching period were few.

It was found that supervising teachers were responsible for most of the guidance of the student teacher and that visits by college supervisors were infrequent.

The evaluation process was undertaken jointly by supervising teachers and college supervisors, but it was evident that more coordination was needed.

As a result of the study, sixteen statements of standards were developed within the four areas, five in curriculum patterns, seven in professional laboratory experiences, three in supervision and one in evaluation.

These standards were submitted to a jury of ten experts for evaluation. In their judgment the standards formed a valid measuring rod for the student teaching programs of the teacher education institutions of New Jersey with major in physical education.

A comparison of standards with practices in the New Jersey Colleges showed that some weakness existed in all four areas. This indicated the desirability of implementing the standards and for this purpose a recommendation was made to the Assistant Commissioner of Higher Education that a committee be appointed to study the standards and to consider putting into practice ten specific recommendations.

Microfilm copy of complete manuscript of 338 pages, \$4.23. Enlargements 6" x 8", 10¢ per page.

## MUSIC SUPERVISION IN THE ELEMENTARY SCHOOLS OF NEW YORK STATE

(Publication No. 3440)

Andrew Maurice Banse, Ed. D.  
New York University, 1951

### The Problem

The purpose of this study was to determine the status, and inquire into the practices of music supervision in the elementary schools of New York State.

### Specific Problems

To complete this investigation it was necessary to:

1. determine the function-patterns of music specialists employed in the school systems,
2. ascertain what music supervisory practices were actually being used by specialists in school systems having some degree of music supervision,
3. discover if such practices were in accord with established principles of supervision,
4. determine to what extent, in teacher-training institutions, provisions were made for the preparation of undergraduate music students in the use of supervisory practices,
5. secure opinions of administrators, music teachers, and grade teachers concerning factors that tend to prevent the establishment of music supervision in some elementary schools.

### Collection, Treatment and Interpretation of Data

#### Specific Problem One

By means of a questionnaire administrators in small school systems indicated the function-patterns of music specialists in their employ. Little more than one-third of the schools had some degree of music supervision.

#### Specific Problem Two

A questionnaire, dealing with music supervisory practices, was sent to music supervisors and supervising instructors. Respondents indicated that the emphasis in the music supervision program seemed to be on maintenance of a set program of music activities rather than upon improvement of teaching.

#### Specific Problem Three

The supervisory practices in use were compared with certain principles of supervision. It was found that the majority of music specialists in schools having music supervision employed practices in agreement with 17 of 36 principles involved. Much disagreement existed between In-Service Training practices and corresponding principles of supervision.

#### Specific Problem Four

By use of a questionnaire, sent to music education departments in New York State, information was obtained concerning the preparation of undergraduates in the use of supervisory practices.

Results showed that most music education departments gave information on supervision in methods courses, with virtually no use of supervisory practices in practice-teaching, or in other curricular activities.

#### Specific Problem Five

A check-list, containing factors tending to prevent establishment of music supervision, was sent to administrators, music teachers, and grade teachers, in schools having no music supervision. Respondents rated the factors in terms of importance in preventing music supervision. All three groups agreed that the lack of preparation of grade teachers in music was of primary importance in preventing music supervision. Among the respondents many believed that specialists should teach special subjects.

A comparison was made of the professional training and teaching experience of music specialists in schools (1) having music supervision, (2) not having supervision. There was little relationship between the training and experience of music specialists, and the use or non-use of supervisory practice.

#### Conclusions

1. This study has shown that music supervision is not universal in small school systems of New York State.

2. In those schools having some degree of music supervision:

- a. the type of supervision tends to be traditional in character.
- b. there is need for more complete observance of established principles of supervision.

3. Most music education departments in New York State give little attention to supervision in the preparation of undergraduates.

4. Professional training, or teaching experience of specialists who participated in this study are not determinants of the presence, or absence, of music supervision in some elementary schools.

5. The lack of preparation of grade teachers in music, and the belief that specialists should teach special subjects seem to be the most important factors preventing use of music supervision.

Recommendations for the improvement of music supervision were made in four areas: the elementary schools, (2) undergraduate preparation of grade teachers in music, (3) undergraduate preparation of music specialists, (4) attitudes of administrators toward music education programs.

Microfilm copy of complete manuscript of 166 pages, \$2.08. Enlargements 6" x 8", 10¢ per page.

#### AN EXPLORATORY STUDY OF THE EFFECTS OF AN IN-SERVICE EDUCATION PROGRAM ON GROUP PROCESSES IN THE CLASSROOM

(Publication No. 3441)

Mary Beauchamp, Ed. D.  
New York University, 1951

The problem was to determine the effects of an

in-service education program on group processes in the classroom. The study tested three hypotheses:

That the document used in the study was an effective instrument in identifying difficulties attending the functioning of group processes in the classroom.

That an in-service program designed to help each teacher with his individualized problems would result in improved group processes in the classrooms.

That as group processes improved social acceptance among children would be greater, attitudes of the children toward school and toward the teacher would be more favorable, satisfaction with group work would be greater, and the teachers' attitudes toward teaching would be more favorable.

Four principles served as operating assumptions for the study:

Humans are socially derived and purposed.

Human behavior is learned and social.

Human evolution and social progress have shown capacity for growth in cooperation and integration.

The real fundamental pressing need of our time is to learn and to create the methods and morals of group enterprise.

The in-service program consisted of a developmental phase during which five group discussions of the document, Group Process and the Classroom Teacher by Louis E. Raths, were held. Each teacher made an analysis of the operation of group processes in his classroom, using the self-rating scale contained in the document. The investigator made an analysis of the operation of group processes in each teacher's classroom using the same rating scale. She administered a social acceptance scale, a scale measuring attitudes toward school and toward the teacher to the children of the participating teachers before and after the study and a scale to measure attitudes toward teaching to the teachers.

The second part of the in-service program was individualized to help each teacher with those factors of group process identified as causing difficulty in his classroom. The help consisted of conferences, group meetings, and trying out techniques in the classrooms.

After the study the teachers and investigator made another rating of the group processes operating in each classroom, interviews were held with each teacher and with four groups of children, the principal of the elementary school evaluated changes he had observed, teachers evaluated the effect of the program, the investigator analyzed the shorthand account kept of the procedures.

From an analysis of the data these conclusions were drawn:

The document, Group Process and the Classroom Teacher, is an effective instrument in identifying difficulties attending group processes. All teachers were able to identify some difficulties. The majority identified three major areas of weakness — role-playing, planning with children, and teaching group processes to children.

The in-service program did result in improved group processes by every measurement and

observation used. The rating scale showed growth on about one-third of the items by the teachers' ratings. All statements, interviews, and evaluations indicated improved group processes.

Social acceptance among the children was greater. Boys' acceptance of boys was statistically significant. There was a trend toward greater acceptance of boys by girls and girls by boys. Girls' acceptance of girls remained the same. Satisfaction with group work was greater. No measurable differences in attitudes toward school, toward the teachers, or teachers' attitudes toward teaching resulted from the study.

The study consisted of the following chapters:

- Chapter I The Problem of the Study
- Chapter II Principles Supporting the Significance of Group Processes
- Chapter III Applications of Group Processes
- Chapter IV Development of an In-Service Program
  - Part I
  - Part II
- Chapter V Development of an In-Service Program
- Chapter VI Results and Evaluation of the In-Service Program
- Chapter VII Conclusions and Implications of the Study

Microfilm copy of complete manuscript of 242 pages, \$3.03. Enlargements 6" x 8", 10¢ per page.

#### **AN EXPERIMENTAL STUDY OF TECHNIQUES FOR INSTITUTING COOPERATIVE WORK PROGRAMS WITH ADOLESCENT STUDENTS**

(Publication No. 3442)

Dixon Addison Bush, Ed. D.  
New York University, 1951

A study based on assumptions of man in this century as a social, non-isolate, planning individual who must work with his fellows to devise the human arrangements of their living. The problem of learning to cooperatively devise these arrangements during the course of the maturation of the student is assumed as the central task of a socially conscious education.

The study is set in the school community of Manumit School in Bucks County, Pennsylvania. The School is a co-educational, progressive, intercultural boarding school situated on an eighty acre estate. It includes grades one through twelve. The focus of the study is on instituting a democratic cooperative work program with forty-six students, age ten through twenty-one, and five of the regular staff members. The work is centered around construction of improved plant facilities to make the school a more satisfactory place to live, study, and teach. This area was chosen because of the obvious need for such work which was recognized by both students and staff.

The study is formulated around four hypotheses:

1. Adolescents can successfully plan and execute a program of community work which will effectively

and importantly alter their surroundings, their education, and hence their whole lives.

2. The planning and execution of such a program can be integrated into the socially required academic standards effectively. This is to say that the program will supplement rather than subvert the work of the students toward college entrance or qualification for a job.

3. The experience of participating in such a program will result in an increase in the adeptness of the students involved in the use of the social skills of democratic participation, and in a maturation of the individual as a person.

4. It will be possible to conduct the experiment in such a manner that the results will serve as a guide in organizing similar programs for other groups of adolescents.

The first hypothesis is supported by material pertinent to the planning work, description of the functioning of the program, and by photographs of the work done.

The second hypothesis is supported by staff estimates of the work of the students compared with their work in past years, by the college and job placement record of the graduating seniors, and by staff estimates of individual students work taken during group evaluations in which the participating staff members evaluated the effect of the work on each participating student, and by individual staff evaluations of the project as an educational venture.

The third hypothesis is supported by descriptions of the planning work and the participation of the students, and by the materials of the staff group and individual evaluations cited above.

The fourth hypothesis is supported in the form of a manual which takes up the operational and educational aspects of the study in detail and evaluates the experience in terms of its applicability to general projects of this type.

Appendices include minutes of the planning sessions of the students and staff, transcripts of the group evaluation of the students in relation to the project, texts of the individual staff evaluations of the project, and material concerning the bookkeeping, photographic recording, etc. It is concluded that all four hypotheses have been substantially supported.

Microfilm copy of complete manuscript of 313 pages, \$3.91. Enlargements 6" x 8", 10¢ per page.

#### **COSTS OF RETIREMENT AND SURVIVORS BENEFITS FOR MISSOURI PUBLIC-SCHOOL TEACHERS**

(Publication No. 3443)

Ivan Dean Calton, Ed. D.  
New York University, 1951

#### **Problem**

The purpose of this study was to determine and to analyze insurable retirement and survivor risks of Missouri public-school teachers for the

purpose of comparing the costs of insuring these risks with the cost of insuring risks of persons now covered by Old-Age and Survivors Insurance of the Federal Social Security Act.

It was hoped that this investigation would determine whether or not, from the cost standpoint of Missouri public-school teachers, they should be covered by Old-Age and Survivors Insurance.

#### Method

First, a study was made of the provisions of the Social Security Act as it would apply to Missouri public-school teachers.

Second, a questionnaire was sent to all teachers in the Public School Retirement System of Missouri ages 35, 50, and 65, relative to the marital and parental status of the teachers and relative to certain employment data about the teachers and their spouses. Further data about employment of the teachers were gathered from the Public School Retirement System of Missouri. From this step the risks of teachers were determined.

Third, a study of trends in risks was made relative to the three groups of teachers at constant age levels.

Fourth, the cost of insuring the retirement and survivor risks of Missouri public-school teachers was computed.

Fifth, the above cost was compared with the cost estimates of Old-Age and Survivors Insurance.

#### Findings

By the time a system of independent group coverage of Missouri public-school teachers would have operated to the year 2000, its cost would be higher than the cost estimates of Old-Age and Survivors Insurance. In the year 2000, the cost of independent group coverage of Missouri public-school teachers would be 10.38 per cent of the earnings of Missouri public-school teachers. For the year 2000, the intermediate-cost estimate of Old-Age and Survivors Insurance is 7.87 per cent of earnings of persons covered by Old-Age and Survivors Insurance. The difference between the cost of independent group coverage for Missouri public-school teachers and the intermediate-cost estimate of Old-Age and Survivors Insurance is 2.51 per cent of earnings. This difference, when applied to the estimated earnings of Missouri public-school teachers in the year 2000, is \$1,293,254.18.

#### Conclusion

From the standpoint of cost to Missouri public-school teachers, their insurable retirement and survivor risks could be covered by Old-Age and Survivors Insurance for a lower cost than by independent group coverage of a similar system for Missouri public-school teachers only.

#### Recommendations

The teaching profession in Missouri should make an effort to inform its members of all the factors involved in coverage by Old-Age and Survivors Insurance. These factors should include the cost of Old-Age and Survivors Insurance as compared with the cost of independent group coverage by a similar

system for Missouri public-school teachers only. The wishes of individual Missouri public-school teachers should be followed as a course of action relative to their coverage by Old-Age and Survivors Insurance. Even with such coverage, the Public School Retirement System of Missouri or a modification of it should be retained if teachers have additional retirement and survivor needs.

Congress should consider amending the Social Security Act to permit coverage of public employees by Old-Age and Survivors Insurance without the abolishment of existing retirement systems.

Microfilm copy of complete manuscript of 213 pages, \$2.66. Enlargements 6" x 8", 10¢ per page.

#### DETERMINATION OF THE PREDICTIVE RELATIONSHIP OF SELECTED FACTORS TO THE SCHOLASTIC ACHIEVEMENT OF 456 VETERANS WITH SERVICE-CONNECTED DISABILITIES

(Publication No. 3477)

Jesse Frank Campbell, Ed. D.  
University of Michigan, 1952

#### The Problem

The specific problem with which this study is concerned is the determination of the predictive relationship of selected factors to the scholastic achievement of 456 veterans with service-connected disabilities.

A. Factors Selected for Study. The following factors were selected for study:

1. To what extent is scholastic achievement affected by the type or degree of severity of the veteran's disability?
2. Of what significance are the veteran's age, marital status and number of dependents in predicting scholastic success?
3. Is employment or service experience significant?
4. What factors in the veteran's high school background are related to his scholastic achievement in an institution of higher learning?
5. Of what importance in predicting academic success are such factors as the length of time the veteran devoted to service and his military rank at the time of discharge?
6. To what extent can the results of psychological tests and vocational preferences be relied upon in predicting scholastic achievement of disabled veterans?

B. Procedure. The following methods and procedures were employed in the study:

1. Various items of data pertaining to the subject's background were collected, tabulated, analyzed, and coded.
2. The subject's scholastic achievement in college was correlated with such quantitative variables as the results of psychological tests, high school scholastic grades, number of months the subject devoted to the armed

services, the kind and degree of severity of the subject's disability, the veteran's age, marital status, and number of dependents.

3. These coefficients of correlation were analyzed to determine which factors were significantly related to scholastic achievement.

4. Multiple correlation coefficients were computed in order to provide evidence concerning the relationship with the criteria of certain combinations of variables.

5. Significance of differences between means was tested by means of the Student-Fischer *t*. The analysis of variance technique was utilized to test the significance of the variances among groups.

#### C. Conclusions.

1. A comparison of honor-point averages among five groups of disabilities failed to reveal any significant differences.

2. In forecasting the scholastic success of the total group and using general scholarship as the criterion, the veteran's age, marital status and number of dependents correlated -.042 and .045 respectively with the criterion.

3. Low correlations were found between occupational experience and academic success in specific college subjects. The highest degree of positive relationship ( $r = .21$ ) existed between employment experience and grades in College English.

4. Among the five disability groups, the coefficients of correlation between college achievement and high school grade-point averages ranged from .074 in the case of veterans with neuropsychiatric disabilities to .386 for those subjects discharged from the service because of skin conditions and communicable and infectious diseases.

5. No significant or consistent relationship was found between general scholarship and the length of time the veteran devoted to service or his military rank at the time of discharge.

6. The coefficients of correlation between the A C E percentile rank and total grade-point averages of veterans within the disability groups ranged from .109 for veterans with amputations and disabilities of the bones, muscles, tendons and joints to .517 for those subjects with respiratory and circulatory conditions and disabilities of the eye, ear, nose and throat. A very slight relationship was discovered between interest test scores and scholastic achievement of disabled veterans in specific college subjects. The highest coefficient of correlation obtained was .31 between musical interests as measured by the Kuder Preference Record and grades earned in college language courses.

7. The combination of number of dependents, percent of disability and length of service as predictive battery otherwise composed of A C E percentile rank and high school grade-point average tended to produce a significant increase in the predictive accuracy of the battery.

8. In light of the limitation imposed on the

validity coefficient by the uncontrolled environmental and non-intellectual determinants of academic performance, the accuracy of prediction was not found to be surprisingly low.

Microfilm copy of complete manuscript of 157 pages, \$1.96. Enlargements 6" x 8", 10¢ per page.

#### SOCIAL ATTITUDES TOWARD CERTAIN CURRICULAR ISSUES IN PUBLIC SECONDARY EDUCATION IN WARREN TOWNSHIP

(Publication No. 3484)

Paul Kenneth Cousino, Ed. D.  
University of Michigan, 1952

The purpose of this investigation was to assess public opinion with respect to certain constantly recurring curricular issues in public secondary education. This survey is unique in that it attempts, through the use of scientific research techniques, to discover what people think should be taught in the public secondary schools of America.

The issues, obtained from a review of the writings, speeches, and discussions of educational leaders, study commissions, and conference groups from Herbert Spencer to the present, are as follows: preparation for a changing world order; training in the basic fundamentals, health, citizenship, occupations, worthy use of leisure time, personality and character development; and the need for special services, such as guidance, placement, and follow-up.

Warren Township, Michigan, a regular congressional township located in the Detroit Metropolitan area, was chosen for investigation. This township had experienced a twenty-fold increase in population since 1900, the impact of which had been felt in the social, economic, political, and educational life of the community. A total of 411 respondents were interviewed by carefully selected and trained interviewers.

The sample survey interview technique involving areal block sub-sampling was utilized in order to give each household in the township an equal chance of being selected in the sample population. Heads of households and/or their spouses if living were randomly selected as interviewees. In this manner variance due to interviewer selection was largely eliminated.

The survey instrument contained a combination of poll and open-end questions designed to give each respondent ample opportunity to register his opinions on each of the issues set forth for study. This questionnaire was carefully pretested with individuals and groups prior to the actual field work in the area. Machine tabulation on Hollerith cards facilitated analysis of data.

The results of this survey revealed that adults in Warren Township overwhelmingly support their schools, that they recognize that the world has changed and that the secondary schools must prepare youth for today's world. Furthermore, these

adults indicated that while the schools must train youth assiduously in the fundamental knowledges, skills, and attitudes, they must also help them understand, care for, and develop their bodies; establish wholesome family-life relationships; give scientific information on sex education; inculcate safe and sane habits of living and offer instruction in effective democratic citizenship, gaining a livelihood, proper use of leisure time, labor-management relationships, and character and personality development. They also felt that the school should help youth understand their own abilities, interests, and needs, and should render assistance in initial job placement and even follow-up placement services when and if needed. Finally these people not only indicated that these are the things that should be taught in today's schools but that they were willing to work for and pay additional tax dollars if need be to obtain these benefits for youth.

Microfilm copy of complete manuscript of 189 pages, \$2.36. Enlargements 6" x 8", 10¢ per page.

**THE DETERMINATION OF MUSICAL EXPERIENCES DESIGNED TO DEVELOP THE MUSICAL COMPETENCIES REQUIRED OF ELEMENTARY SCHOOL TEACHERS IN MARYLAND**

(Publication No. 3445)

Jessie Laib Fleming, Ed. D.  
New York University, 1951

The purpose in this investigation was to determine what experiences in music should be provided for prospective elementary school teachers in Maryland in order to develop those musical competencies necessary to carry on the music program of the elementary schools in that state.

A determination was made of those elementary school musical activities which educators in Maryland felt had particular importance for their program. A list of elementary school musical activities suggested in many sources for the United States as a whole was submitted to a representative sampling of Maryland elementary school teachers, principals, supervisors and music supervisors for rating as to the importance of each activity for inclusion in the Maryland program. The results provided a list of 83 musical activities in seven categories.

A determination was next made of the musical competencies which teachers should possess in order to conduct the 83 musical activities of the desirable Maryland elementary school program. This was done by extracting from pertinent literature in the field of teacher education in music the musical competencies which were suggested for elementary teachers generally to possess. These competencies were then related by the investigator specifically to each of the 83 musical activities. A jury of music educators then validated this work. A list of 88 musical competencies resulted.

A compilation was then made, from an examination of pertinent literature, of musical experiences at college level suggested for prospective elementary school teachers in the United States as a whole. These musical experiences were then related by a jury of music specialists in teacher education to the list of 88 musical competencies found necessary for Maryland elementary teachers to possess. The result was a list of 89 musical experiences which were judged suitable of making a significant enough contribution to the development of the 88 musical competencies to require that they be included in the college program for the preparation of elementary teachers.

The musical experiences which comprise the existing required program in the Maryland state teachers colleges were determined by interviewing the music instructors in those institutions. A comparison was then made between the desired program and the existing program. It was found that of the 89 experiences which should be included in the program, 47 are now provided adequately, 30 are provided to a small extent, and 12 are not provided at all. Those provided were offered in two courses — Music Literature and Music Fundamentals.

Among the conclusions were the following:

1. The ideal elementary school music program for Maryland appears in keeping with the program suggested for the United States as a whole in all but three categories.

2. The variety of musical competencies and the levels of achievement to which elementary teachers must possess them are relatively advanced for a person who is not a music specialist.

3. The Maryland state teachers colleges now adequately provide only 47 of the 89 musical experiences which are necessary to develop the required competencies, thus indicating necessity for some modification in the present program.

4. Only 41 percent of the most valuable musical experiences are adequately provided, the emphasis being on less valuable experiences.

It was recommended that (1) the necessary musical experiences which are not now provided adequately in the program of the Maryland state teachers colleges should be included in that program and (2) that a committee be organized by members of the Maryland State Department of Education for the purposes of (a) determining the most effective means of including all the desired experiences in the college program and (b) organizing the materials which would comprise the course of study for the program including the 89 desired musical experiences.

Microfilm copy of complete manuscript of 231 pages, \$2.89. Enlargements 6" x 8", 10¢ per page.

**A GUIDE FOR THE HEALTH COORDINATOR  
IN THE VOCATIONAL HIGH SCHOOLS  
OF THE CITY OF NEW YORK**

(Publication No. 3449)

Elsa F. Hintze, Ed.D.  
New York University, 1951

Research into the work of the health coordinators in the vocational high schools of the City of New York and into functional and inclusive programs of health service to students of these schools resulted in the preparation of a practical and comprehensive guide for the use of administrators, supervisors and coordinators of the school health service. While New York City is unique because of its size and character, many of the health service practices which might be considered desirable for it are also applicable to other cities throughout the United States.

Health service is defined as that phase of health education program which seeks

1. to determine the health status of the pupil
2. to bring the pupil to optimal health status by obtaining his cooperation and that of his parents in the protection and maintenance of physical, mental, and emotional health
3. to interpret to the faculty the health problems of the pupil in terms of his curricular needs
4. to interpret to the school doctor and nurse the mental, emotional and physical demands of the school program to the end that adjustments may be planned for the pupil where needed
5. to promote greater health and safety in the school by presenting to the administrator evidence of conditions in the school plant that prevent accepted standards of health and safety from being maintained
6. to provide adequate service in emergency illness or accidents
7. to coordinate the school health service with the community health program through contact with all forms of community agencies
8. to establish and maintain adequate, cumulative health records for all pupils.

Procedures designed to assist the health coordinator to direct the health service program in accordance with these principles or objectives are described.

Recent studies related to health service such as those done in the field of vision testing and in nutrition are included. Implications for health service in the findings of these studies are indicated.

Suggestions and recommendations for future study in health service areas such as a study of the methods of obtaining closer cooperation between the school and the community agencies and a study of the type and extent of assistance needed in dealing with mental, emotional and social health problems are made.

The personality and professional preparation which might lead to success as a health coordinator are presented.

The guide concludes with an annotated bibliography designed to acquaint the health coordinator

with a varied sampling of the sources of information in the field.

The guide should be of value not only to the health coordinator, but also to the school administrator, other faculty members, and to the other members of the health service team.

Microfilm copy of complete manuscript of 298 pages, \$3.73. Enlargements 6" x 8", 10¢ per page.

**SUCCESS PATTERNS IN INDUSTRIAL EDUCATION**

**- A STUDY OF FACTORS OF INFLUENCE  
IN THE BACKGROUNDS OF 237 FIRST DEGREE  
AND 166 SECOND DEGREE GRADUATES  
OF MINNESOTA, WITH MAJOR INTEREST  
IN INDUSTRIAL EDUCATION**

(Publication No. 3420)

Raymond Howard Larson, Ph.D.  
University of Minnesota, 1951

The study gathers, organizes and presents data pertinent to an investigation of the mean differences among various background patterns. The most important are learning areas, test scores, experiences, salaries, ages, high school rank, "rating by others" and certain parental and personal factors. The mean differences among and within various sub-groups (i.e. those returning the questionnaire; graduating with distinction; that did not teach; and, receiving the second degree) and the effect of native and transfer classification within each sub-group were investigated.

All possible campus sources of data were used — admission information, test scores, rating sheets and the transcript of credits — supplemented by a questionnaire.

The questionnaire was returned by 65.21 per cent of the total of First and Second Degree Graduates. The author concluded, on the basis of evidence presented, that the group returning the questionnaire was representative of the total group.

The study is, in the main, based upon Honor Point Ratios of credits in various attempted learning areas — "Total credits," "College of Education," "Other than the College of Education," "Industrial Shop," "Industrial Professional," "Professional Studies," "Social Studies," "Science," "Foreign Language," "Communications," "Mathematics," "Directed Teaching" and "Miscellaneous." The Honor Point Ratio was determined on the basis of "A" equals 3, "B" equals 2, "C" equals 1, "D" equals 0, and a failure equals -1. A grade of "satisfactory," "pass" or "grade" was figured as "C" for the first degree and as "B" on the second degree level.

In the statistical interpretation of the data, the arithmetic mean was used as the central tendency; the standard deviation was used as the measure of variability; and the "t" test of significance was employed to determine the level of the significance of a difference.

**Major Findings**

1. The typical First Degree graduate of the University of Minnesota, with the major interest in Industrial Education, was born and reared in the State. In fact, the group is predominantly native to the Twin Cities area at the time of entrance into the University.

2. The First Degree is weakest in academic areas, mathematics and science particularly, and these are normally assumed to be supplementary to industrial teaching.

3. Those of the First Degree graduates who completed their work with distinction are a highly select group of students. They are predominantly transfer students with more than 60 quarter credits of work attempted at institutions other than the University of Minnesota.

4. Graduates with first degrees who left teaching or did not enter the industrial field concentrate around the central tendency. Those who are weakest and strongest scholastically are still teaching.

5. Graduates at the First Degree level who transfer into the University of Minnesota make better college records than those native to the University of Minnesota. This strength is more in the academic areas than in the practical subjects of the industrial education curriculum.

Practically no difference in scholastic attainment exists between the native and transfer students at the masters level.

6. Instructors, supervisors and others rated the transfer students — on both the First and Second degree levels — above the native students.

7. Native students, on both the First and Second degree levels have had more experiences in earning fields other than teaching, but less teaching experiences than transfer students.

8. Transfer students, on both the First and Second degree levels, realize greater financial returns than do native students on either a nine-months or total-income basis.

9. Second Degree graduates of Minnesota who earned first degrees in institutions other than the College of Education, are a more select group than the First Degree graduates from the College of Education, University of Minnesota. The undergraduate records of those with First Degree other than in the College of Education, compare favorably with the undergraduate records of those of the First Degree recipients who later attained the Second Degree.

10. Instructors, supervisors, and others rate those attaining the Second Degree higher than the students who do not attain the Second Degree.

11. The earning of Second Degree proves a good investment for industrial education majors as those with Second Degrees are better compensated on a nine-months or total-income basis than First Degree recipients.

Microfilm copy of complete manuscript of 301 pages, \$3.76. Enlargements 6" x 8", 10¢ per page.

**THE MICHIGAN EDUCATION ASSOCIATION  
AS AN INTEREST GROUP, 1852-1950**

(Publication No. 3531)

George Albert Male, Ph. D.  
University of Michigan, 1952

The underlying hypothesis of this study is that teachers have not been neutral in the midst of pressure group activity, but that they have organized and have, themselves, constituted a pressure group seeking to promote certain ends. Further, it is hypothesized that teachers' organizations have not been oblivious to other pressure groups but have, instead, modified their areas of interest and methods in response to pressures from aggressive organizations in the social order.

All the printed matter, including proceedings and bulletins, of the Michigan Education Association were examined. Journals of other teachers organizations such as the Michigan Federation of Teachers were examined also. The viewpoints toward education of other groups such as organized labor and the farmers were obtained from newspapers and proceedings of these groups.

This study shows that most of the improvements in education and in the teaching profession over the last ninety-eight year period in Michigan have come about through group pressure from teachers. There is no indication that these improvements have come about automatically or through the mere passage of time. In fact, in most instances such as attempts to secure a larger school administrative unit there was strong opposition from such groups as the farmers.

While clearly a pressure group, the Michigan Education Association has sought to avoid the appearance of being a narrowly selfish one, apparently in deference to the long standing tradition that teachers should not be an active, aggressive element outside the classroom, even when their own welfare was at stake. Thus, the Michigan Education Association has disowned the use of such methods as the strike or collective bargaining which it was claimed would antagonize groups in the community. Moreover, wherever possible, this teachers' association has tried to show that a proposed change would benefit the school children and society as well as the teacher. Thus, retirement pay for teachers was cited as a means of eliminating teachers made incompetent by advanced age.

The Michigan Education Association has also preferred to improve the teacher's social and economic status by such indirect methods as obtaining larger school administrative units and higher certification standards. Yet, in the 1930's under pressure from a competing teachers' organization affiliated with organized labor, the Michigan Education Association campaigned for tenure, sick leave plans, credit unions, and larger state appropriations for the teachers' retirement fund and for the public schools. In so doing it received the label of the "school lobby."

This study indicates that while it may be regrettable that interest groups do not base their actions on the needs and interests of all segments of the social order, to ask teachers' organizations to do so while other pressure groups continue to behave otherwise would leave the teaching profession and the schools in a precarious position. Further, it seems clear from this study that organized interest groups have come to be an integral part of our society and that organizations are needed to protect the interests of the schools and of the teachers.

Microfilm copy of complete manuscript of 547 pages, \$6.84. Enlargements 6" x 8", 10¢ per page

#### FACTORS AFFECTING THE EMPLOYMENT OF NEW AND INEXPERIENCED TEACHERS IN THE PUBLIC SCHOOLS OF MINNESOTA

(Publication No. 3092)

Theodore Carol Sjoding, Ph. D.  
University of Minnesota, 1951

#### Purpose and Method

The objective of this study was to establish a basis for a broader, more accurate study of the problem of supplying the new, inexperienced teachers required each year for the public schools of Minnesota. The generalizations were based on an examination of the records of new secondary and graded school teachers entering service every other year during the period 1922-23 to 1948-49. Ungraded elementary school teachers were studied for the years 1930-31, 1935-36, 1940-41, 1945-46, and 1948-49. Individual records of 18,071 teachers, including 8780 new secondary teachers, 4732 new graded elementary teachers, and 4559 new ungraded rural teachers were examined.

The mean, minimum and maximum annual numbers of new and inexperienced teachers employed for the three groups were as follows:

	Mean	Minimum	Maximum
Secondary	512	205	910
Graded Elementary	289	103	579
Ungraded Elementary	912	402	1524

#### Major Findings

The major factors which affect the employment of new teachers in the public schools of Minnesota were found to be: (1) Enrollment fluctuations, (2) size of school system, (3) grade level and subject matter field, (4) region of state and (5) general economic conditions.

1. Generally it was found that increases or decreases in school enrollment were followed by corresponding changes in the number of beginning teachers.

2. On the secondary and graded elementary school levels for the entire period, rates of employment of new, inexperienced teachers in the smallest school systems were from 10 to 65 times as large as the rate in the largest systems.

3. On the basis of accession rates, the graded school teachers constituted the most stable of the three groups studied, with a mean annual accession rate of 4.2 per cent. Ungraded school teachers were the least stable, with a mean annual accession rate of 13.2 per cent. The rate for secondary school teachers was 7.4. On the secondary level, marked contrasts were found in the accessions by subject matter fields.

4. Agricultural regions employed new teachers at a rate two to ten times the rate in industrialized, more thickly populated regions.

5. Trends were roughly parallel between the employment rate of new, inexperienced teachers and three indexes of economic activity, industrial production, nonagricultural employment and factory payrolls.

6. Minnesota's institutions supplied a yearly average of 81.4 per cent of the secondary teachers, 90 per cent of the graded elementary teachers, and almost all of the ungraded rural teachers. The number of new teachers employed from out-of-state fluctuated with general economic conditions. The proportions of secondary school teachers supplied by the University of Minnesota and the liberal arts colleges of the state showed a decline during the entire period with the teachers colleges showing a decided increase. The proportions of new graded elementary teachers supplied by the University of Minnesota and the liberal arts colleges showed increases from .5 per cent and 1.3 per cent respectively in 1923 to 10.6 per cent and 4.9 per cent in 1949. At the beginning and end of the period studied approximately two thirds of the ungraded rural school teachers were supplied by Minnesota high school training departments.

#### Major Conclusion

The problem of estimating the number of new teachers required for Minnesota's public schools for any one year is a complex problem involving teacher certification standards, teaching level, teaching field for secondary teachers, enrollment trends, employment of out-of-state teachers, and economic conditions.

#### Major Recommendation

A long range study should be made by all teacher training institutions of the state working cooperatively on the requirements for new, inexperienced teachers. This long range plan should be corrected annually. It should include the need for new secondary school teachers in each teaching field as well as the annual requirements for new teachers in the graded elementary and ungraded rural schools.

Microfilm copy of complete manuscript of 343 pages, \$4.29. Enlargements 6" x 8", 10¢ per page.

**A DIGEST OF RESEARCH CONCLUSIONS  
IN BUSINESS EDUCATION PERTAINING  
TO TRAINING FOR SECRETARIAL  
AND BOOKKEEPING OPERATIONS**

(Publication No. 3453)

Ethel Christine Stroop, Ed. D.  
New York University, 1951

**The Problem**

The purpose of this study was to summarize for the use of teachers, supervisors, curriculum committees, and investigators, the results of research studies relating to the problems of business education that pertain to training for secretarial and bookkeeping occupations.

**Method of Solution**

A bibliography of pertinent research studies completed at the various colleges and universities in fulfillment of requirements for graduate degrees was compiled.

A copy of the bibliography for each school was sent to the head of the business education department. Each bibliography was accompanied by a letter and a set of instructions, requesting that the following things be done: (1) Cross out those studies which would not represent a contribution to this digest. (2) Add any study which has been completed in your department and which you feel should be considered in this digest.

Three hundred twenty-three studies given on the returned bibliographies were then secured and their findings recorded verbatim on three-by-five cards.

**Findings**

These findings were classified according to subject matter. As a result, the findings were organized into eight topics, which were: Objectives, Goals of Achievement, Pupil Personnel, Teacher Personnel, Guidance, Prognosis, Curriculum, and Methods.

For each of these areas, significant questions were raised. Findings from 120 of the 323 studies which were read were found to be relevant answers to these questions and were therefore incorporated into the final report.

Generalizations were made for each of the eight topics in terms of the questions raised about them. These generalizations were then discussed and many of their implications indicated.

A total of forty-four generalizations were made. Seven dealt with Objectives; six with Goals of Achievement; one with Pupil Personnel; seven with Teacher Personnel; six with Guidance; three with Prognosis; three with Curriculum; and eleven with Methods.

**Conclusions**

Since space is limited for this abstract, only the generalizations and recommendations for Prognosis are reported here as an example of the method used for all eight areas. The conclusions are:

1. There does not seem to be any existing test or combination of tests which will adequately predict ability to learn and use shorthand successfully. General grade average and marks in modern languages seem to be the most predictive of shorthand achievement.

2. According to the findings of this study, there is no sure way of predicting ability in typewriting. It seems, however, that prediction based on the results of a battery of tests may be more reliable than that based on any one test although no particular battery of tests is known to yield the desired results.

3. According to the findings, bookkeeping ability can be predicted reasonably well by use of the modified form of the Thurstone Clerical Test, tests in fundamentals of arithmetic, and average freshman grades. Intelligence quotient alone does not seem to be a reliable means of predicting ability in bookkeeping.

**Recommendations**

A total of twenty-six recommendations were made. Four dealt with Objectives; three with Goals of Achievement; one with Pupil Personnel; four with Teacher Personnel; four with Guidance; three with Prognosis; three with Curriculum; and four with Methods.

Since space is limited for this abstract, only the three recommendations given for Prognosis are given here. They are:

1. Pupils desiring to take business subjects, especially shorthand, typewriting, or bookkeeping, should be advised concerning their chances of success; but they usually should be allowed to try any of these subjects if they are sufficiently interested.

2. Administrators should provide courses for pupils to transfer into if it is found, after a fair trial, but they are not going to be successful in shorthand, typewriting, or bookkeeping. A course in general business or in general clerical work probably would meet their needs.

3. Business men should be encouraged to consider the school records of applicants for office positions. Schools should make records readily available for business men.

Taken from A Study of Shorthand Teaching: Comparison of Outcomes in the Learning of Shorthand Effected by Differences in Teaching Methodology, by Benjamin Franklin Davis, 1936. pp. 45-50.

First, the learning exercises should take place in the same form as final use.

Second, the learning should take place in the same manner as final use.

Third, the learning exercises should include from the very start all the skills required at the expert level.

Fourth, the method should insure sufficient practice for all the skills, not individually, but as a harmonious single complex skill.

Fifth, if the individual learner has difficulty with any one of the skills he should be able to isolate the part giving trouble for additional training

and then secure further practice in context with the others as they appear in their final relationship.

Sixth, the material should be graded to insure repetition and practice where and as needed, according to the difficulty of the learning task.

Seventh, the psychological should precede the logical order, with the latter presented only in response to a felt need.

Eighth, formal exercises and devices should be used sparingly, and then only in response to a definite need.

Ninth, the formation of habits which must later be broken or altered should be avoided.

Tenth, objective measures of success should be provided which are in accord with final purposes.

Eleventh, the measures for success should be known to the student and easily used by him for gauging his own work.

Twelfth, provision should be made for individual adaptations.

Thirteenth, the pupil should be encouraged to seek his own solutions and generalizations without teacher aid.

Fourteenth, the teacher should facilitate pupil-generalization only where such aid is necessary for its successful completion and only to the extent necessary.

Microfilm copy of complete manuscript of 166 pages, \$2.08. Enlargements 6" x 8", 10¢ per page.

#### THE RELATION OF RELIGION TO PUBLIC EDUCATION IN AMERICA

(Publication No. 3456)

Frank N. Trager, Ph.D.  
New York University, 1951

This dissertation demonstrates that the public schools of America should teach about religion. This does not mean that there should be instruction or indoctrination for or against religion; rather that the public schools should "bring religion into their curriculum for extensive and intensive examination, just as they do any other important experience" — controversial or otherwise.

The demonstration of this thesis is presented in five chapters:

1. The exposure of present confusion surrounding the issue and the various meanings of the terms employed to describe it.

2. The examination of the American historical background of the church-state relation in order to determine whether teaching about religion violates historical tradition.

3. The examination of the constitutional and other legal aspects of the relation between religion and public education in order to determine the presence or absence of legal prohibition.

4. The analysis of modern American educational philosophy in order to discover whether teaching about religion in the public school is consistent with such philosophy.

5. The review of certain practical difficulties or roadblocks preventing the incorporation of religious matter in the curriculum.

Chapter I: Entering the forum of religion and public education one is deluged by a babel of terms: "released time," "sectarianism," "religious education," "separation of church and state," "moral and spiritual values," "indoctrination," "religion," etc. Part of this confusion may be attributed to the different aspects of the problem itself. For example, there is a related series of issues arising from the amounts and kinds of federal and state financial aid to education. Other parts of the confusion, however, must be attributed to careless use of language, to misinterpretation of the historical development regarding the teaching of religion in the schools, to the dicta of the courts when handing down decisions, and to a combination of inconsistency and fear when educators deal with the problem.

A fourfold typology of the concept of religion and consequent determination of the kinds of religious education are presented in order to thread through the discussion. Similarly, clarification and definition of the key words are given. An overview of the recent literature in the field reveals the confusion and simultaneously offers a variety of solutions to the problem. Whereas all such views claim historical and legal precedent, and assert loyalty to the principle of separation of church and state, they vary in applying such views from those who would exclude "religion" from the public schools to those who seek a sound formula for incorporating "religion" in the curriculum.

Chapter II: The Argument From History: No one who appeals to history can single out a uniform tradition on separation of church and state. Single establishment in the 17th Century gave way to multiple establishment in the 18th Century. Some form of establishment persisted in several states through the first half of the 19th Century. Separation in America occurs and is of a special kind. The fight for the free exercise of religion, the growth of dissenting ideas and the rationalist philosophy of the 18th Century combine to establish the First Amendment (and the other sections of the) Bill of Rights. This Amendment was thought to be necessary by Jefferson, useful but not essential by Madison. These two great leaders are rightfully claimed as spokesmen for "the strict principle of separation." Religion to them — from which the state and school should be separated — meant orthodox revealed, supernaturalistic religion. They opposed "establishment of a church" and indoctrination by the clergy of such religion in the school. They argued to sever the legal and pecuniary bindings between church and state. But theirs was a mutually friendly separation of church and state which did not govern the concept, teaching about religion.

The Constitution is silent on matters of education. The latter was primarily theological until the second half of the 18th Century. Gradually as the public school came into its own in the 19th Century it became free from sectarian rivalry, but it retained the Horace Mann compromise by letting religion speak for itself.

It is a truism to say that history proves nothing. The appeal to history sometimes assists in establishing acceptance for a point of view. In this instance the appeal to history establishes no single view of separation; it, as a minimum, supports disestablishment, freedom and concern for religion and for religious equality, compulsory public school education free from its sectarian origins and control but yet devoted to the significance of religion as such.

**Chapter III: The Argument From Law:** The review of federal and state constitutions and statutes presents a bewildering assortment of views and practices. The First and Fourteenth Amendments brought about the disestablishment of the financial and legal connections between state and church. The states almost uniformly adopted prohibitions against "imparting sectarian instruction" but for the most part in law and in practice permitted religion to speak for itself in the public school in many other ways.

Four Supreme Court cases profoundly affected the problem. The Pierce Case prevented Oregon from illegalizing parochial schools. The Cochran Case permitted the State of Louisiana to give textbooks to all students including those in the parochial schools. The Everson Case likewise upheld the right of New Jersey to give transportation to both parochial and public school children. The McCollum case (for the first time witnessed the Supreme Court striking down a legislative enactment on the ground of violation of the first clause of the First Amendment concerning establishment of religion) illegalized certain kinds of released time practices in Illinois. In the latter two cases, along with the holdings of the Supreme Court, the Court issued *dicta* on the meaning of the "wall of separation." The views announced by the Supreme Court have been seriously questioned in this dissertation and elsewhere.

The problem of direct federal aid to education represents a more intense conflict. Obviously we now have some forms of state aid to parochial education in the form of textbooks, transportation, health, hot lunches and the like, but direct aid has thus far been blocked.

One simple conclusion emerges from the historical and legal record: Nothing in American history, or in American law, prevents public school teachers from teaching about religion in a public school, provided that the teacher avoids "sectarian instruction." Whatever be the ultimate outcomes on released time, on dismissed time, on federal aid to education, this conclusion still stands. One can be for or against the McCollum, Everson, Cochran and Pierce holdings; one can be for or against other auxiliary aids; but nothing in the record prevents teaching about religion by public school teachers in public schools in the normal course of everyday teaching.

**Chapters IV and V:** It was discovered that whether educational philosophy was essentialist or progressivist in character, whether the curriculum be regarded as subject-matter or experience, curriculum construction has in part attended to the inclusion of religious matter despite the controversies

over religion. But it has done this relatively in an unplanned and grudging fashion. The justifiable inclusion of religious matter in the curriculum enables the pupil to judge and to understand more efficiently the religious experience and environment of his culture and his community.

Conservative and liberal educators alike agree that the American school cannot be neutral with respect to the ideals of democracy, and the moral and spiritual nurture of the child. They may and should, if they are to be self-consistent, approach religion and other controversial issues not by any kind of indoctrinating methods but by clarifying the meaning, imparting information, examining the claims of the partisans and opponents, reviewing the evidence, describing the historical and cultural roles, inviting responsible discussion and criticism.

In sum, it is clear that religion is a part of the culture; is part of the living of each person; that religions have played meaningful roles in the history of the world; that a significant number of people in the world find sanction for their performance and explanation for their questions in the revelations of religion; that children in our culture inevitably raise questions and are concerned about issues that are by consent religious in character. Therefore, for these and related reasons, essentialists and progressivists cannot outlaw religion from the public school. This conclusion is further buttressed by the almost unanimous concern educators have for the morality of education. If education is normative in character — then it is inescapable for the educator to help the student learn about the nature of norms, of values, of ethical principles and their application. And once he does this, the educator, short of violating the ethics and science of his profession, cannot refrain from treating religion as one source or one theory or one view related to the derivation and sanction for morality. He does this, moreover, by disclosing his own views if he so wishes, but certainly by teaching about all pertinent views including the religious.

Microfilm copy of complete manuscript of 327 pages, \$4.09. Enlargements 6" x 8", 10¢ per page.

**PROGRAM DESIGN IN RESEARCH  
AN EXPLORATORY STUDY OF COOPERATIVELY  
PLANNED DOCTORAL DISSERTATIONS  
IN EDUCATIONAL PSYCHOLOGY**

(Publication No. 3457)

S. Woodrow Van Court, Ph. D.  
New York University, 1951

**Problem**

The problem was to explore the scientific method of having several doctoral candidates write their theses cooperatively in central areas with particular reference to research on national problems in Educational Psychology.

### Population

The population consisted of 1,068 doctoral candidates, their chairmen, and 50 scientists representing all levels of experience with coordinated research. Also in the universe were nine comparable schools of education and six governmental defense agencies engaged in research programs.

### Method

The method employed was an activity analysis in terms of the function of the participating units. This approach made it possible for pertinent parts of the historical, normative-survey and comparative methods to be integrated into an exploratory study. Sources utilized included articles, records, a classification system and interview schedule formulated for the problem.

### Procedure

The procedure was to gather instances of research planning that lent themselves to a cooperative approach in the design of doctoral dissertations. This involved the collection of data on Policy and Individual Designs and then a comparison of these data for Program Design possibilities. Finally, programs in process were investigated to determine special problems encountered in the use of the method.

### Findings

1. That no one organization made all dissertations available for perusal, suggesting a need for a central organization to act as a clearing-house. Candidates, using the Classification System of this study, might submit theses to a national agency for scientific personnel information and review for relevance to national needs.

2. That in the Individual Design of studies there was a very uneven pattern with respect to area, method, nature and population utilized. This indicated wide gaps in knowledges and demonstrated the need for research in all applicable areas and methods.

3. That on Policy Design, organizations were structured to do cooperative research planning but were not functioning. This might be remedied by the National Science Foundation and more attention at the university level to research problems that are of national import.

4. That, although it was the policy of agencies in the Department of Defense to encourage psychological research that was of mutual concern to schools of education, no such cooperative research projects were in operation. Both schools and agencies might benefit by more active cooperation in the exploration of problem areas in psychology as a Social Science.

5. That few previous researches lent themselves to Programming, that some in-process studies were amenable, and that the real potential was in future research where individuals might work together throughout a study.

6. That the main problems faced in cooperative research were communication, basic and applied research, interpersonal relations and competent

research personnel. The last problem might be alleviated by periodic rotation of scientific personnel in and out of governmental and university laboratories.

7. That less than three per cent of the dissertations perused approached Program Design. Each program analyzed used one or more aspects of the method, but no one group utilized all features. Collectively the cooperative studies did incorporate all parts of the method and demonstrated their effectiveness. Accordingly, it was recommended that several doctoral candidates and professors with similar interests in a central problem be encouraged to work together in the formulation of the problem, the preparation of an outline, collection and treatment of the data and the writing of a final, integrated report.

The increasing complexity of human knowledges, the possibility of improving research by the unique advantages of a coordinated approach, the chance to make educational studies pay and the opportunity to teach sound and fruitful interpersonal relationships all point in the direction of increased use of Program Design in Research.

Microfilm copy of complete manuscript of 365 pages, \$4.56. Enlargements 6" x 8", 10¢ per page.

### DUAL-PURPOSE INDUSTRIAL EDUCATION AT THE COLLEGE LEVEL

(Publication No. 3422)

Gustave Sulo Wall, Ph. D.  
University of Minnesota, 1951

The study here reported was designed and carried on through two phases. The initial phase sought opinions and practices in industrial arts teacher education for the purpose of creating a dual-purpose industrial education curriculum. The second phase was concerned with the evaluation of a curriculum proposal created on the basis of the initial findings.

Two forms were utilized in the initial phase of the study. One, the "Check Sheet," obtained opinions from 492 industrial teacher educators. The second form, the "Supplementary Sheet," gathered expression of pertinent practices from 109 institutions conducting industrial teacher education programs. The combined total of 601 completed forms represented 520 individuals, who were scattered in 128 institutions (69% of those contacted) located in 42 states.

More than seven-tenths of the respondents were individuals whose sole function was in the preparation of industrial arts teachers. Only slightly more than 5% of the group listed vocational-industrial teacher preparation as their field of service. The remainder of the group, slightly more than one-fifth, functioned in serving both of the above classifications.

The initial inquiry revealed that industrial educators favored a change in the distribution of the

total credit. This change would allot an equal portion to general, professional, and shop/drawing development in the preparation of industrial arts teachers; the professional to include both general and special (industrial) aspects.

Although only one-third of the group believed it desirable to increase the total credit requirement over that in other Education departments, the evidence gathered with regard to inclusion of industrial work experience as a worthwhile asset led to increasing the total credits for graduation under the curriculum proposal created.

The proposed industrial arts teacher education curriculum, based on a total of 136 semester credits, required eight credits of military and health/physical education and eight credits to be earned through industrial work experience. The former increased the student week to 48 hours, on the basis of three hours per week for each of sixteen credits per term. The latter added to the total time by approximately one academic year by demanding three summer periods for coordinated work experience in industry.

The group expressed the belief that shop/drawing instruction should begin in the first year. Specialization in shopwork was deemed to be desirable, this to be attained by earning about fifteen credits in one of the several industrial arts areas. This, in effect, would provide the student with a usable measure of training for industry. This value was further substantiated by the evidence that three-fourths of the emphasis given in shop/drawing course work serves the same purpose, whether it is given as training for industry or as preparation for industrial arts teaching.

That industrial work experience and college taught shop/drawing courses, together with appropriately scheduled and taught professional courses, serve to assist the student in evaluating his goals was readily concluded from the responses received.

The group expressed the opinion that the industrial arts teacher preparation curriculum should include a preponderance of college taught shop/drawing work, this to be spread throughout the several areas which make up the industrial arts curriculum area. With this thought in mind the proposed curriculum provided that a minimum of one shop major (14 credits — 3 being in related drawing); two shop minors (9 credits each — 2 being in related drawing); and a nine credit drawing minor attained by completing two credits in Design be required of each potential teacher. The remainder of the total shop/drawing credit required that credits be earned in "Crafts" and "General Shop" along with some electives. The eight credits earned for industrial work experience increased the total shop/drawing requirement to 48 credits, of which 40 were to be earned in college taught courses. The schedule pattern advocated spreading the shop/drawing work throughout the four years, the number of credits decreasing in succeeding years.

The creation of the natural dual-purpose curriculum — the primary purpose being industrial arts teacher preparation and the secondary purpose being training for industry and the whole to serve the

student in evaluating his goals — was made possible and feasible by the application of a split-semester modified block plan of scheduling the shop/drawing work. This also made fuller use of the usual student time demand by requiring attendance for two and one-half of the three hours usually demanded of students in earning one credit. Other course work could, by this arrangement, be scheduled in the traditional manner.

The proposed curriculum was highly acceptable to the 215 industrial teacher educators who evaluated it in the second phase of the study. This relatively smaller group was equally representative as was the initial phase group, the personnel being simply a smaller cross section of the original respondents.

The proposed curriculum, which was an integral part of the report sent to the original respondents was evaluated by their checking "YES" or "NO" and writing any comment desired for each of three questions.

The first question: — "In general, will the curriculum design — its overall requirements, schedule plans, shop/drawing minimums and purposes — provide good industrial arts teacher education?" — was affirmed by more than 97 per cent of the respondents.

Similarly, the second question: — "Do its essential provisions indicate that the student will have a good opportunity for evaluating his goals?" — was also affirmed by over 95 per cent of the group.

The third question: — "Is the measure of industrial training, a natural concomitant, detrimental to the primary purpose — industrial arts teacher preparation?" — was voted by almost three-fourths of the group as being not detrimental to the stated primary purpose, that of industrial arts teacher education.

On the basis of the findings it was an easy recommendation to make that such a dual-purpose curriculum should be established and that a long term study be made to permit determining the true effectiveness of it in all its ramifications through actual practice.

Microfilm copy of complete manuscript of 282 pages, \$3.53. Enlargements 6" x 8", 10¢ per page.

#### THE TREATMENT OF INTERNATIONAL RELATIONS IN TWELFTH GRADE SOCIAL STUDIES TEXTBOOKS

(Publication No. 3416)

Edith West, Ph. D.  
University of Minnesota, 1951

#### Purposes of Study

Many approaches are needed to create international understanding. One is to improve the treatment of international relations in school textbooks. This study was designed to discover what information is presented about international relations in twelfth grade textbooks on sociology, government, economics, and problems of democracy, what duplication exists between these texts and those

on history, and whether or not the accounts are likely to develop international understanding.

#### Procedure

The study is based upon texts published or revised from January 1, 1947 to June 1, 1951. A count was made of the space devoted to international relations and the division of this space among different topics. A qualitative analysis was made to determine what generalizations are developed and whether or not the information is accurate, up-to-date, likely to facilitate learning, and likely to develop attitudes favorable to a world community. Detailed criteria were established to guide the analysis and to indicate to the reader the analyst's value judgments. The criteria are based upon the findings of educational and social psychologists as well as upon the writings of social scientists. In order to compare the treatment of international relations in twelfth grade texts with that in history texts, reliance was placed upon an earlier report prepared for the National Commission for UNESCO on The Treatment of International Agencies in School History Textbooks in the United States.

#### Summary of Findings

1. In general the treatment of international relations is accurate as to facts, but students may gain false impressions from some of the books because of misleading language, the omission of important data, or the presentation of only one side of a controversial issue. The most serious instances of misleading impressions are related to the power of international agencies.

2. In a few instances revision of material has been hasty and incomplete. Few books contain material about the political, economic, and social activities of the UN.

3. Great differences exist in the amount of space devoted to international relations. In general, the space is greater than that in similar texts of the mid-twenties but less than that in present-day history texts.

4. Considerable duplication exists both as to topics treated and generalizations developed between twelfth grade texts and history texts and between government and sociology texts.

5. The material tends to be difficult for twelfth graders. Most authors use many specialized terms without defining them.

6. Authors do little to develop interest by showing how international relations are related to the lives of students. The selection of topics does not always seem wise in the light of student interests and experiences, and the treatment frequently lacks the concrete examples needed both for interest and learning.

7. The books are likely to do little to develop attitudes favorable to a world community. Students are not shown how they stand to benefit in their everyday lives from the operation of international agencies.

#### Conclusions

Many improvements could be made in accounts of international relations by making only minor

modifications in existing accounts. Others would require considerable rewriting but little or no additional space. By establishing criteria for the selection of topics, by limiting the number of topics and developing each fully, by limiting the number of technical terms employed, and by a more careful selection of illustrations and teaching aids, authors could do much to facilitate greater learning and the development of international attitudes.

Microfilm copy of complete manuscript of 651 pages, \$8.14. Enlargements 6" x 8", 10¢ per page.

#### EDUCATION AND PSYCHOLOGY

#### A STUDY OF THE RELATIONSHIP BETWEEN THE SOCIAL CLASS BACKGROUND OF JUNIOR HIGH SCHOOL STUDENTS AND THE REWARDS AND PUNISHMENTS OF THE JUNIOR HIGH SCHOOLS

(Publication No. 3437)

Stephen Abrahamson, Ph. D.  
New York University, 1951

The hypothesis of the study states that between the social class backgrounds of junior high school students and the rewards and punishments meted out to them there exists a relationship in which the students of higher social class backgrounds tend to receive a disproportionately large share of the rewards and a disproportionately small share of the punishments, and the students of lower social class backgrounds tend to receive a disproportionately small share of the rewards and a disproportionately large share of the punishments.

To test the hypothesis, the investigator obtained information about the rewards and punishments distributed to students in twenty-four homeroom groups in six junior high schools, located in six different communities. The data collected pertained to six reward and punishment factors: academic grades, favors and punishments conferred by the teachers, social acceptance of the students by their classmates, offices held by the students, participation in extra-curricular activities, and prizes and awards.

To test the hypothesis statistically, the investigator assumed a form of null hypothesis: that is, that there was no connection between social class and the distribution of rewards and punishments and that the distribution of rewards and punishments would therefore be proportionate. Using chi-square, he then compared the actual distributions of rewards and punishments according to social class with theoretical distributions of rewards and punishments based on proportionate distribution. The coefficient of contingency was employed to determine the correlation — if any — between the social class of the students and the rewards and punishments meted out to the students.

#### Findings of the study

1. There was a substantial correlation found

in each of the six schools between social class and the distribution of grades.

2. Substantial correlations were found at all of the six schools between social class and social acceptance.

3. A significant relationship between social class and office-holding was discovered at all of the six schools.

4. The investigator found that students of higher social class background tended to receive a disproportionately large share of prizes while children of lower class background tended to receive none.

5. A statistically significant relationship was found in four of the schools between social class of the students and the number of extra-curricular activities they participated in.

6. In the case of favors and punishments conferred by the teachers, slight correlations — statistically significant — were found in the total distributions though not at the individual schools.

From the data collected in the six schools, the investigator concluded:

1. In the samples tabulated there was found a relationship in which the students of higher social class background tended to receive a disproportionately large share of the rewards and a disproportionately small share of the punishments while students of lower social class background tended to receive a disproportionately small share of the rewards and a disproportionately large share of the punishments.

2. The same relationship very probably exists throughout the six schools and not just in the selected samples.

3. The same relationship probably exists in almost any junior high school where there are three social classes represented in the student population.

4. The social class backgrounds of the students are a vital factor in determining whether they will receive rewards or not.

Synthesizing the data collected with other evidence already published, the investigator further concluded:

5. The reward and penalty systems of junior high schools probably reflect middle class standards and values.

6. Teachers in junior high schools, being of upper-middle or lower-middle class backgrounds themselves, are probably operating within the reward and penalty systems in a way that reflects the values of our social status system and are — albeit unconsciously — favoring students of higher social class background, penalizing students of lower social class background, and treating the "middle" group rather fairly in general.

Not only is there a question of how to meet the challenge posed here, but also how much time our strife-torn world will allow for the repairing of our democratic fences

Microfilm copy of complete manuscript of 215 pages, \$2.69. Enlargements 6" x 8", 10¢ per page.

## RELATION OF CERTAIN PERSONALITY COMPONENTS TO ACHIEVEMENT IN SECONDARY SCHOOL SCIENCE

(Publication No. 3446)

Henry Gould, Ph. D.  
New York University, 1951

### Problem

To determine whether a distinctive pattern of certain components of personality is prevalent among high-school students who elect secondary-school science as a major subject, and is lacking among those who do not elect science as a major subject

### Significance of the Problem

Many students with comparable I.Q.'s fail in certain subject areas while taking scholastic honors in others. Evidently, there is something other than I.Q. that determines proficiency in certain subject-matter areas. This investigation seeks certain elements or factors of the total personality which, when taken together, might be used as the basis of an instrument for the prediction of achievement in secondary-school science.

### Subjects

The entire ninth-year class (157 boys and girls) attending the Ossining, New York, Junior-Senior High School during the 1946-47 school year.

### Measuring Instruments Used

Bell Adjustment Inventory; Bernreuter Personality Inventory; Mental Health Analysis; Otis Quick-Scoring Mental Ability Test, Gamma, Form Bm; A.C.E. Cooperative Science Test for Grades 7, 8, and 9, Form R; June 1948 Biology Regents Examination; Teachers' Final Grades as recorded for 1947-48 School Year

### General Procedure

All raw scores were converted into T-scores. The product-moment method was used to calculate coefficients of intercorrelation for the twenty personality components purported to be measured by the personality inventories. In addition, coefficients of correlation were calculated between each of the personality components and the following criteria: I.Q., general science, non-science, and biology achievement scores. The foregoing criteria were inter-correlated.

Multiple R's were calculated, by the Doolittle Method, between the personality components and I.Q. scores, and between the personality components (with and without the inclusion of I.Q.) and each of the criteria: general science, non-science, and biology achievement scores.

Best-fitting multiple R's were calculated, by the Wherry-Doolittle Method, between the personality components and the criteria: general science, non-science, and biology achievement scores.

All multiple R's were corrected for chance errors. Regression equations were calculated wherever feasible.

All findings were arbitrarily selected at the 1 per cent level of confidence when tested against the Null hypothesis.

The reliability of the compared groups was tested by means of critical ratios calculated for the differences between the means. Also employed was the "z" test of differences between two "r's" having one variable in common.

#### Findings

No significant statistical differences are found between the achievement of boys and girls in general science when the total distribution of scores is considered.

The zero order coefficient of correlation, calculated to be .75, between I.Q. and general science achievement scores, is not increased when the personality components are added as variables in a multiple R.

Nothing is to be gained by calculating a regression equation to predict achievement scores in non-science subjects from the combined use of the twenty personality components since the calculated corrected multiple R of .446 is lower than the zero order coefficients of .458 and .553 calculated between the criterion and I.Q. and general science scores, respectively.

A multiple R of .835 is found between the personality components and achievement in biology. This R is higher than the zero order coefficients of .42 and .64 calculated between the criterion and I.Q. and general science scores, respectively.

When six personality components are selected by the Wherry-Doolittle Method for inclusion in a regression equation to predict biology achievement scores, a corrected multiple R of .789 is calculated. Predicted values are found to correlate to the extent of .623 with actual obtained scores.

The pattern of personality components associated with biology achievement is found to differ from the patterns associated with general science and non-science achievement.

#### Tentative Conclusions and Recommendations

Variations between predicted and actual scores are too great to permit the use of the regression equation to predict biology achievement scores for individuals. The significant statistical findings, however, indicate that closer agreement might possibly be obtained by more accurate and refined techniques.

There is a need for personality inventories and similar measuring instruments so constructed that high scores on each would be indicative of favorable responses.

There is a definite need for the re-defining and re-refining of the aspects of the total personality.

Microfilm copy of complete manuscript of 217 pages, \$2.71. Enlargements 6" x 8", 10¢ per page.

#### THE EFFECT OF POST-HYPNOTIC SUGGESTION ON SOME ASPECTS OF LEARNING PERFORMANCE AND CERTAIN OTHER INTELLECTUAL AND PSYCHOMOTOR TASKS

(Publication No. 3448)

Emanuel Frederick Hammer, Ph.D.  
New York University, 1951

The purpose of this investigation was to determine whether or not post-hypnotic suggestion can improve some aspects of hypnotizable students' application and efficiency as applied to a number of selected performances, connected directly or indirectly with schoolwork.

Those subjects were chosen for the study who were able to be hypnotized to the somnambulistic stage as specified by the following criteria: (1) those who were not able to recall what took place in the hypnotic trance (i.e. post-hypnotic amnesia), and (2) those in whom positive visual and auditory hallucinations could be produced post-hypnotically. Nine subjects, in all, were used.

Each experimental unit with a single subject consisted of four "runs" (i.e. the complete battery of test performances), two normal and two post-hypnotic. With half of the subjects, the order Normal, Post-Hypnotic, Post-Hypnotic, Normal was used, with the other half Post-Hypnotic, Normal, Normal, Post-Hypnotic was the order employed. This method was utilized as a device to guard against the influence of practice and fatigue as far as possible, while allowing each subject to serve as his own control.

Before the post-hypnotic runs the subject was given post-hypnotic suggestions of ease, confidence, motivation and increased ability. The following performances were tested: Tapping, Speed of Aimed Dotting, Cancellation of Letters, Drawer Finding, Card Sorting, Digit Span Forward and Backward, Counting by 3's, Writing the Alphabet Backwards, Adding, Simultaneous Adding and Subtracting, Learning Nonsense Syllables, Learning Meaningful Syllables, Delayed Memory for Nonsense and Meaningful Syllables, Digit Symbol Substitution, Line Drawing Judgment, Time Judgment, Number Series Completion, Verbal Analogies, and Speed of Reading Comprehension.

On the following performances the differences between means, in favor of the post-hypnotic state, were found to be statistically significant at the five per cent level of confidence, or above: Tapping, Index of Fatigue (based on Tapping test), Drawer Finding, Digit Symbol Substitution, Learning of Meaningful Syllables, Speed of Association, Time Judgment, Cancellation of Letters, Index of Efficiency (based on Cancellation test), Digit Span Forward and Backward, Card Sorting, Counting by 3's, Adding, Simultaneous Adding and Subtracting, Number Series Completion and Speed of Reading Comprehension.

The conclusions, as based on the nine highly hypnotizable subjects in this investigation and the employment of the waking method of hypnosis, are:

1. Post-hypnotic suggestion can increase psychomotor speed and endurance and decrease physical fatigue.
2. Post-hypnotic suggestion can increase both span of attention and duration of attention, as well as routine clerical performances.
3. Post-hypnotic suggestion can increase speed of learning as tested by Meaningful Syllables lists and Digit Symbol Substitution.
4. Post-hypnotic suggestion can increase speed of association, mental alertness, concentration and mental efficiency in general.
5. Post-hypnotic suggestion can heighten accuracy of perception of small time intervals.
6. Post-hypnotic suggestion can improve the application of abstract abilities in reference to number content.
7. Post-hypnotic suggestion can improve speed of reading comprehension.
8. Though not an experimental conclusion, it is the investigator's clinical impression that heightened enjoyment on performances can readily be achieved and made to operate during post-hypnotic periods.
9. To the extent to which the above abilities are related to schoolwork, the hypothesis is supported that post-hypnotic suggestion can be of aid in hypnotizable college students' schoolwork.
10. The results tend to support such statements in the literature as that hypnosis is a "powerful motivational determinant"<sup>1</sup> and that post-hypnotic suggestions "are carried out with an energy which is quite foreign to normal human conduct."<sup>2</sup>

This experiment represents a preliminary investigation, and it must be emphasized that because of the small number of subjects, conclusions can be made only with caution.

1. E. Boring, A History of Experimental Psychology, (2nd Edition) New York: Appleton-Century-Crofts, 1950, p. 696.
2. G. Estabrooks, Hypnotism, New York: E. P. Dutton and Company, Incorporated, 1943, p. 132.

Microfilm copy of complete manuscript of 254 pages, \$3.18. Enlargements 6" x 8", 10¢ per page.

#### A CRITICAL ANALYSIS OF THE RELATIONSHIP BETWEEN OCCUPATIONAL GOALS, SOCIAL ADJUSTMENT AND SOCIAL STATUS OF HIGH SCHOOL SENIORS IN URBAN NEGRO HIGH SCHOOLS IN TWO STATES

(Publication No. 3452)

Benjamin Franklin Smith, Ph.D.  
New York University, 1951

#### The Problem

The chief objective of this study was to discover the interrelationship of occupational goals, social adjustment and social class position of

urban Negro high school seniors. The evidence used to solve the problem was gathered from a sample of 265 seniors chosen from the Negro high schools in Durham, and Charlotte, North Carolina and Richmond, Virginia. This investigation was limited to those students who were classified as seniors by the high schools in each of the three cities. These students were currently enrolled in school and were attending class during the school year 1950-1951.

#### Procedure

The Warner concept of social class was used in assessing social position of the families of the students studied. The data used in determining class position were collected from the parents of each student. Three competently trained sociologists reviewed the data and assessed the social class.

Information pertaining to the occupational goals of students was secured by means of a guided interview. The questionnaire schedule was pre-tested on a small sample of individuals who attended the Y. M. C. A. in Raleigh, North Carolina during the last week in August, 1950.

Social Adjustment was determined by the Washburne Social Adjustment Inventory, Thaspic Edition. The Inventory was administered in the classrooms of the schools from which the sample was drawn. All tests and interviews were executed by the author.

Before combining the data for statistical treatment, the null hypothesis was tested. In each case, except sympathy scores for lower lower and upper lower class girls, the null hypothesis was retained. When the sympathy scores for lower and upper lower class girls were eliminated, the remaining data were combined and treated as if it came from the same population.

#### Findings

The analysis of the relationship between adjustment and social strata revealed that the lower lower class is inferior to all other classes on such traits as truthfulness, happiness and alienation. There is no significant difference between lower and upper lower class boys on sympathy. However, there is a continued increase in the feeling of affinity to people from the lower class to the upper middle class.

The lower lower and lower middle classes are inferior in adjustment to the upper lower and upper middle classes on the cluster of traits measured by the subtest Purpose. The upper middle class is superior in the abilities measured by the subtest Control.

The evidence supports the thesis that there is a positive relationship between occupational hopes, wishes and expectations and social class. As we go up the class ladder, we find the number of individuals in each class who aspire for professional occupations increasing.

The lower lower class seniors show less variability in goals than members of the other classes. The greatest variation in vocational aspirations of the lower lower class senior was found in the skilled occupational group.

The upper middle class senior faces the future with a greater degree of assurance than do members

of the two lower classes. The degree of certainty for success in the preferred occupation diminishes with class. In spite of this fact, members of each class tend to aspire to those occupations which regional culture has established as Negro jobs.

The lower class senior is less satisfied with conditions of his life and shows a pointed decline in vocational aspirations from elementary school days to senior year in high school.

Social adjustment and occupational goals were found to be unrelated in all except two instances. Alienation was found to be significantly related to failure in securing work during after-school hours. The relationship between failure and self control is highly significant.

Microfilm copy of complete manuscript of 145 pages, \$1.81. Enlargements 6" x 8", 10¢ per page.

**A COMPARATIVE STUDY OF THE RELATIVE EFFECTIVENESS OF TWO METHODS OF TEACHING A THIRTY HOUR COURSE IN PSYCHOLOGY IN MODIFYING ATTITUDES ASSOCIATED WITH RACIAL, RELIGIOUS AND ETHNIC PREJUDICE**

(Publication No. 3458)

Gerald Stanley Wieder, Ph. D.  
New York University, 1951

The purpose of this investigation was to study the relative effectiveness of two methods of teaching a thirty hour course in psychology in modifying attitudes associated with racial, religious and ethnic prejudice; one method utilizing such group therapy procedures as nondirective methods of instruction and sociodrama, while the other employed the traditional lecture-discussion method. A secondary purpose of this research was to investigate the relationship between personality adjustment and the social attitudes with which this study is concerned. The problem of course content learning for the two classes taught by the investigator was also examined.

Three instruments were employed, namely, the California Public Opinion Study E-F Scales, The Index of Adjustment and Values and the Minnesota Multiphasic Inventory, both before and after the experimental period to measure any changes which may have taken place. An objective type course content examination was administered to the two experimental classes at the mid-point and end of the semester. The two experimental classes were conducted by the investigator. A third class taught by another instructor who used traditional methods of instruction served as one control. Finally, another group which was composed of students registered in various courses within the same curriculum served as a time factor control. All groups were compared on the significant variables and appeared to come from the same parent population.

The major purpose of the study was accomplished in the finding that a course in Practical Psychology conducted by using such group therapy

procedures as student-centered classroom practice and sociodrama measurably modified attitudes associated with racial, religious and ethnic prejudice. A similar course in Practical Psychology when conducted along traditional lecture-discussion methods of instruction did not significantly modify these same attitudes. The factor of student attendance at Brooklyn College within the Vocational Diploma Program did not produce significant modification of these same social attitudes.

Inspection of the variable changes comprising both E and F scales revealed that the most significantly effected scale clusters occurring within the Group Therapy Class, were the conventionality and authoritarian-aggression items.

The data on the Index of Adjustment and Values is generally supportive of the attitude scale findings. Significant increases in the Self Concept (Scale I) and Acceptance of Self (Scale II) took place for the Group Therapy Class only. The Discrepancy Index (Adjustment Index III-I) while moving in the direction of greater adjustment did not approach significance.

The Minnesota Multiphasic Inventory did not reflect results which would tend to support the basic hypotheses of this investigation. Significant movement took place within the Group Therapy Class on the Pd (increased) and M (decreased) variables. The Lecture-Discussion Class shifted significantly upward on the K, Hs, Hy and Sc scales. Movement within the control groups was limited to a significant increase in the F variable for Control Group I.

A subsidiary finding for the two groups taught by the investigator was the practical similarity of course content test results on both mid-term and end-term examinations.

The data obtained in this study supported the findings of those investigators who believe prejudice to be primarily a symptom of a personality need syndrome, which is not readily amenable to modification by factual information, exhortation or other simple linear approaches. It was observed that modification of these social attitudes was effected by a more global approach to the total personality structure. It was further indicated that non-directive and role playing techniques contributed to a personal growth that was reflected in increased self-insight, greater self-acceptance and a decrease in attitudes associated with racial, religious and ethnic prejudice.

Microfilm copy of complete manuscript of 192 pages, \$2.40. Enlargements 6" x 8", 10¢ per page.

## ENGINEERING, AERONAUTICAL

**AN ANALYTICAL AND EXPERIMENTAL  
INVESTIGATION OF THE RESPONSE TIME  
FOR QUASI-STEADY, VISCOUS, COMPRESSIBLE  
FLOW IN CAPILLARY TUBING INITIALLY  
SUBJECTED TO A STEP FUNCTION  
IN PRESSURE**

(Publication No. 3490)

Arnold Lionel Ducoffe, Ph.D.  
University of Michigan, 1952

This paper presents a study of the factors affecting the response time of typical supersonic wind tunnel pressure instrumentation systems subjected initially to a step function in pressure. The response time is defined as the time required for the pressure in the sensing element to attain a value equal to 101 per cent of the equilibrium pressure. An investigation is made to explore the extent to which existing theory agrees with experiment. In addition, a series of experiments are conducted to show the effect of variation of the important geometric and dynamic parameters on the response time.

Flow equations for the motion of the fluid are derived assuming (1) that quasi-steady, developed flow exists over the entire length of the tubing; (2) that changes of state are described by an isothermal process; and (3) that a continuum type of flow exists. The boundary equations are derived with the assumption of a constant volume, isothermal expansion of the fluid from the sensing element (pressure capsule) at one end of the tubing, and a constant pressure at the other end.

The capsule pressure variation as a function of time is obtained experimentally by transducing the capsule diaphragm motion into a voltage signal by means of a linear differential transformer. The motion of the diaphragm mechanically changes the coupling of the transformer secondary windings (connected in opposition), thus resulting in an output signal dependent on the diaphragm position (or capsule pressure). The transformer signal is then a-c amplified, rectified, phase detected, d-c amplified, and fed into a Brush recorder. The time variation of the capsule pressure is then recorded on Brush recorder tapes. Seven parameters (orifice diameter, capillary-tube length and diameter, connecting-tube length and diameter, reservoir pressure, and initial line and capsule pressure) are chosen for investigation of their effects on the response time. The range for each parameter was selected to conform with present-day supersonic wind tunnel installations as well as for larger supersonic tunnels at present in the planning stage.

The results are presented in two series of graphs. The first series presents a comparison of the theoretical and experimental variation of capsule pressure with time. Also included are plots of the spatial pressure distribution in the tubing at several time intervals between the initial condition of a step function in pressure and the equilibrium condition. The second series of curves presents the

effect of variations of each of the important parameters on the response time. Criteria for slip flow and free-molecule flow are also presented in an appendix.

On the basis of the theoretical and experimental results, the following conclusions are presented:

1. Good agreement between theory and experiment indicates that the approximations introduced in the derivation of the flow equations are well justified.
2. The response time is greatly increased for
  - a. decreased capillary-tube diameter; and
  - b. a decrease in reservoir pressure below 10 mm Hg absolute.
3. The response time is moderately increased for
  - a. increased capillary-tube length; and
  - b. increased connecting-tube length or diameter.
4. The response time is not appreciably affected by
  - a. orifice diameter; and
  - b. initial line and capsule pressure.
5. Slip-flow corrections assume importance for flow in small-bore tubing as the mean tube pressure drops below 20 mm Hg absolute.
6. Free-molecule flow probably never occurs in supersonic wind tunnel systems.

Microfilm copy of complete manuscript of 127 pages, \$1.59. Enlargements 6" x 8", 10¢ per page.

**THE EFFECT OF RELATIVE VELOCITY  
ON THE EVAPORATION OF A LIQUID  
FUEL SPRAY**

(Publication No. 3508)

August Reuben Hanson, Ph.D.  
University of Michigan, 1952

Sprays injected into a stream of air do not, in general, have the same velocity as the air. That is, there exists a relative velocity between the spray as a whole and the air. This dissertation reports the results of an experimental study which set out to measure the effect of such relative velocity on the evaporation of a liquid fuel sprayed into an air-stream.

A hollow-cone spray of n-hexane was injected downstream into the test-section of a wind tunnel in such a way that the axis of the spray-cone coincided with the centerline of the tunnel. The total mass of spray passing any transverse plane of the test-section was measured by means of a rack of open-end collector tubes. By making collections at various distances downstream from the tip of the nozzle it was possible to determine the mass of spray evaporated as a function of this distance. The relative velocity between the spray and the airstream was varied by changing the velocity of the airstream. Downstream traverses made at different velocities permitted a comparison of the amount of spray evaporated for various relative velocities.

It was found that relative velocity has a strong effect on the rate of evaporation of the spray. The relationship is such that increasing relative velocity increases the rate of evaporation.

A subsidiary investigation was made of the effects on air-stream turbulence caused by modifying the normal, open-jet configuration of the tunnel by the installation of a closed duct in the test-section. Measurements of the scale and decay of turbulence from screens in the wind tunnel showed that the closed duct brings the turbulence closer to a state of isotropy. The measurements also showed that, for otherwise identical test conditions, the closed duct produced values of scale and intensity which were lower than the corresponding values which exist in the open-jet arrangement.

Collection tests were found to be inadequate to establish the effect of changes in scale on rate of evaporation of the spray.

Photography of spray drops was used to check the collection data. As a consequence of difficulties in calibration, a rather thorough investigation of photographic errors was necessary. The tests showed that if exposure and development were controlled to give a negative density of 1.8 to 2.0 it was possible to measure drops of diameter  $0.002 \leq d \leq 0.010$  inch to within about 5 per cent; whereas for drops of such size that  $0.0005 \leq d \leq 0.002$  inch the error was 10 per cent or higher.

A correlation of the present data with existing theory was carried out. Although the theory has, in the past, been verified only for single drops of moderately volatile substances, the results reported here indicate that the form of the evaporation equation is correct for sprays, but that an empirical constant which occurs in the equation needs checking.

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## ENGINEERING, CHEMICAL

### HEAT TRANSFER FROM A METAL SURFACE TO FIXED FLUIDIZED BEDS OF FINE PARTICLES

(Publication No. 3466)

Richard Neil Bartholomew, Sc. D.  
University of Michigan, 1951

Heat transfer coefficients from a metal surface to fixed fluidized beds of fine particles were determined in a steel reactor 4 inches in internal diameter and 30 inches high. Beds of sand, calcium carbonate, or aluminum particles were used in both wide and narrow size ranges between 48 and 200 Tyler screen mesh, at solid concentrations from 5 to 46 per cent by volume. Air at approximately atmospheric pressure was used at superficial linear velocities between 0.6 and 5.0 feet per second to maintain the beds in a fluidized condition. The mean temperature of the reactor wall was maintained

at approximately 400 or 600 degrees Fahrenheit, and mean bed temperatures varied from 250 to 600 degrees Fahrenheit. The range of measured heat transfer coefficients was from 10 to 66 B. T. U. per hour per square foot per degree Fahrenheit.

Pronounced longitudinal temperature gradients were observed in the reactor wall at low solid concentrations, decreasing to zero as the solid concentration was increased to about 20 per cent. Only minor longitudinal temperature gradients were found in the bed, and the bed temperatures under fluidized conditions were almost identical with those observed immediately upon the sudden cessation of air flow. The only appreciable difference in the physical properties of the solid particles was a 200-fold range of thermal conductivity, and this was found to be an insignificant factor in heat transfer, within the limit of experimental error. The important variables were found to be the density and diameter of the particles, the density, specific heat, viscosity, and thermal conductivity of the air, the solid concentration, and the rate of air flow. The heat transfer coefficients were relatively insensitive to variations in the operating conditions at solid concentrations of 20 to 45 per cent.

The heat transfer data were correlated on a single curve in terms of four dimensionless groups, and an equation representing the correlation was derived. The data for mixtures of widely varying particle size were correlated on the same basis as closely sized fractions by use of a mass-fraction mean particle diameter. The fluidization data confirmed a correlation previously proposed in the literature and extended it into a more useful range.

A theoretical analysis of the problem indicated that the primary mechanism of heat transfer to fluidized beds may be from the reactor wall to the particles by conduction and convection, then from the particles to the fluid by convection.

The primary conclusion was that phenomena associated with even the most complex physical systems can be correlated in terms of dimensionless groups of variables which recur throughout studies of heat, mass, and momentum transfer.

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### HEAT TRANSFER AND PRESSURE DROP IN SYSTEMS OF GASES AND SOLIDS IN FIXED AND FLUIDIZED BEDS

(Publication No. 3491)

Jacob Eichhorn, Ph. D.  
University of Michigan, 1951

This investigation was undertaken to determine the rates at which heat is transferred between beds of solid particles and gas passing through the beds, the particles being stationary in a "fixed" bed and also in motion in a "fluidized" bed. These data are important in evaluating the temperature difference between catalyst surfaces and reactants

passing over the surface during heterogenous reactions and also in other industrial operations such as pebble heating.

Coefficients for heat transfer between solid and gas in packed beds have been determined under steady state conditions as a function of particle size, gas velocity, and gas properties.

In the fixed bed runs the particle diameter ranges from .0658 cm. (24/28 mesh) to .0102 cm. (150/170 mesh) and the modified Reynolds number from 1 to 18. Both air and carbon dioxide are used. In the fluidization work particles .0841 cm. (20/24 mesh) to .0140 cm. (100/115 mesh) are used. The modified Reynolds number extends from 0.7 to 28. Air is used in all the runs.

Dielectric heating is used to generate heat continuously in a system of plastic particles. The heat is removed by a gas stream flowing through the bed of heated particles. Temperatures of the solid and gas in the reactor are measured with thermocouples. It is shown that under the conditions of the experiment the thermocouples in the fixed bed measure the temperature of the solid. The temperature difference between solid and gas is evaluated at the exit of the fixed bed and shown to be constant throughout the bed.

The fixed bed heat transfer coefficients are correlated as  $j$  factors and plotted versus values of modified Reynolds number. The particle diameter is a parameter in such a plot. These heat transfer data are compared with the  $j$  factors obtained in previous mass transfer experiments. The fixed bed pressure drop data are in close agreement with previously published work.

The fluidized bed heat transfer work indicates that the solid and gas temperatures for a bed of particles 48/60 mesh and smaller are essentially identical and constant throughout the fluidized system. It is suggested that fluidized bed heat transfer calculations be treated simply as a gas stream heat balance.

The range of the major operating variables in this study was:

**Fixed Bed:**

particle diameter:	.0658 to .0102 cm. (24/28 to 150/170 mesh)
particle shape:	spherical
bed depth:	1 in. and 1-1/2 in.
Z/D <sub>P</sub> :	39 to 265
modified Reynolds number:	1 to 18
Prandtl number:	.818 (air), .862 (carbon dioxide)

**Fluidized Bed:**

particle diameter:	.0841 to .0140 cm. (20/24 to 100/115 mesh)
particle shape:	spherical
initial bed depth:	1 in.
fraction void:	.50 to .75
modified Reynolds number:	.7 to 28
Prandtl number:	.818 (air)

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## THE THERMAL CONDUCTIVITIES OF SOME ORGANIC LIQUIDS

(Publication No. 3488)

Marion Frederick Dick, Ph.D.  
University of Michigan, 1951

An apparatus was constructed and the thermal conductivities of nineteen liquid organic compounds were measured. The measurements were used to test theoretical and empirical equations from the literature which relate thermal conductivity to other physical properties. Correlation of the available physical properties of the liquids with thermal conductivity was attempted. The effect of molecular structure upon thermal conductivity was investigated.

The instrument which was used for measuring the thermal conductivities is a horizontal parallel plate type in which the liquid is held as a thin circular disc. The heat flows vertically downward through the liquid disc. This design provides for changing the thickness of the liquid. The precision of the instrument is such that the results are within 1 per cent of the mean value. The thermal conductivities reported are within 2 per cent of the absolute values.

Measurements of thermal conductivity were made at 20°C and 60°C. The compounds, which have molecular weights of about 350, include seven isomeric ethers, esters of varying structure, a hydrocarbon, and commercial lubricating oils.

The theoretical equations do not satisfactorily predict the results of this research. For one equation the calculated results differ from the observed by a factor of two and for another the calculated results were in error by a factor of one-half. Though the theoretical equations predict the data in the literature reasonably well, they cannot be extended to more complex high molecular weight liquids.

One empirical equation out of the six investigated was found to predict the observed results well enough for engineering use. This equation predicts the order of magnitude of the thermal conductivity but does not account for deviations found for compounds of varying structure.

The only available physical property which shows evidence of correlation with thermal conductivity is the ASTM viscosity slope. ASTM slope is an empirical number but viscosity data from the literature indicate that molecular structure has an effect upon ASTM slope.

A correlation between thermal conductivity and the number of atoms in the longest straight chain of the compounds is indicated. It was found that the thermal conductivities increase with increases in the number of atoms in the straight chain. This correlation can be improved by applying corrections for the effects of side chains. The presence of side chains tend to reduce the thermal conductivity.

Molecular structure has a definite effect upon the thermal conductivities of liquids which has not been satisfactorily accounted for in the present theoretical and empirical equations. The results of this research indicate that thermal conductivity

can be correlated with the number of atoms in the longest straight chain of the compound when corrections are made for the effects of side chains.

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#### AN ELECTRONIC SPRAY ANALYZER FOR ELECTRICALLY CONDUCTING PARTICLES

(Publication No. 3498)

Jacob Myer Geist, Ph. D.  
University of Michigan, 1951

This is a study of the usefulness and the limitations of an electronic device for measuring the drop size and the size distribution in the spray from a nozzle while the nozzle is in operation.

The electronic spray analyzer incorporates a probe carrying a positive electrical potential, upon which the drops in a spray impinge. If the drops conduct electricity, pulses of negative potential occur in the probe. These pulses are amplified, sorted according to size, and counted.

The relationship between the particle size and the size of the pulse obtained at the input to the amplifier is apparently independent of the material of the drop so long as the material is a conductor. Metal spheres with diameters from 500 microns to 6340 microns and water drops with diameters from 2590 microns to 4550 microns followed the same calibration curve. For drops of material having relatively high conductivity the size of the pulse varied directly with the probe potential and approximately with the 1.6 power of the particle diameter, at least over a range from 1/2 to 6 times the diameter of the probe wire. The size of the pulse is also dependent upon the position of impact of the drop along the length of the probe.

These characteristics of the probe are explained by considering the probe to act as a condenser with a fixed charge. The change in the capacitance of the probe due to the placement of a spherical conductor in contact with the probe creates a pulse of negative potential, dependent upon the electric field around the probe.

With further development of the geometry of the probe and of the electronic counter, the electronic spray analyzer may offer a rapid method for determining the drop size and size distribution in the spray of an operating nozzle with a minimum of error due to sampling.

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#### VAPOR-LIQUID EQUILIBRIA IN BINARY HYDROCARBON-WATER SYSTEMS

(Publication No. 3521)

Riki Kobayashi, Ph. D.  
University of Michigan, 1951

Experimental vapor-liquid equilibria data were obtained in the two-phase and three-phase regions for the propane-water system at several temperatures from 54 deg. F to 300 deg. F and pressures from 100 to 2800 pounds per square inch absolute (psia). The system was studied with relative thoroughness, especially in the region surrounding 205.7 deg. F and 637 psia, the conditions at which the vapor phase and the propane-liquid phase become continuously identical. In the experimental determination of phase compositions, propane and water were brought to equilibrium in a high pressure cell and the co-existing phases were sampled and analyzed.

Experimental data on the solubility of water in the propane-rich phases were obtained for the three phase envelope, and in the two-phase region for the isotherms of 100, 150, 190, 205.7, 230, 260, and 300 deg. F up to 2800 psia. The solubility of propane in water was determined experimentally in the three-phase region, and in the two-phase region for isotherms of 54, 100, 133, 190, 205.7, 230, 260, and 300 deg. F up to 2800 psia. The experimental data are presented graphically using pressure, temperature, and composition as variables. Excepting at low pressures and high temperatures, the solubility of water in propane is very low, the concentrations determined generally being less than 5 mol per cent water in propane. The solubility of propane in liquid water was extremely low, never exceeding 0.07 mol per cent propane over the range of the conditions covered.

A qualitative analysis of the phase relations for the complete propane-water system based on the Phase Rule of Willard Gibbs and the experimental data has been made.

A correlation showing the solubility of water in light hydrocarbon liquids and vapors as a function of temperature, molal volume, and the molecular weight to a lesser extent, has been developed. For complex hydrocarbon mixtures the water content can be predicted successfully in the vapor phase, in the hydrocarbon-rich liquid phase in the three-phase region at low pressures, and in the compressed hydrocarbon fluid phase. The limitations of this correlation when applied to complex hydrocarbon-water systems, are discussed.

A thermodynamic equation relating the solubility of a pure hydrocarbon in water to the partial volumetric properties of that hydrocarbon in the coexisting phases and the Henry's Law constant has been applied to the methane-water, ethane-water, and the propane-water systems. The solubility of propane in water has been calculated from 3000 to 10,000 psia by the application of this equation to the experimental vapor-liquid equilibria data of the propane-water system below 3000 psia and the

volumetric data of pure propane from 0 to 10,000 psia. The validity of the extrapolation is supported by the conclusions drawn from the thermodynamic study made of the methane-water and the ethane-water systems. The partial molal volumes of the dissolved hydrocarbons obtained from this study have been applied to estimate the effect of dissolved hydrocarbons on the density of water.

Minimum and maximum isobaric solubilities of gases in water at high pressures are discussed qualitatively in relation to Henry's Law and the volumetric behavior of the solute-rich phase.

A detailed discussion of the experimental equipment, procedures, and techniques used in the determination of the propane-water vapor-liquid equilibria relationships is given.

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#### THE EFFECT OF PRESSURE ON THE DEHYDRATION OF BUTANOL-1 OVER AN ALUMINA-SILICA CATALYST

(Publication No. 3532)

John Frederick Maurer, Ph.D.  
University of Michigan, 1950

A method for determining the step of maximum resistance in a sequence of steps which may occur in a heterogeneous catalyzed gas-phase chemical reaction is presented.

The theoretical derivation for this method is based on the law of mass action, an adsorption process as outlined by Dr. I. Langmuir, the existence of a rate controlling step, and the similarity of the adsorption of reactant and products on the active catalyst surface. From the above considerations it was possible to derive a distinct relationship between the total pressure and the initial heterogeneous rate of reaction for each step of a catalyzed gas-phase chemical reaction.

The experimental procedure for this method consists of utilizing a high pressure-high temperature reactor to determine the influence of total pressure on the initial heterogeneous rate of reaction.

The purpose of this investigation was to study the effect of pressure over the range 0 to 7500 pounds per square inch gauge on the initial heterogeneous rate of dehydration of butanol-1 over an alumina-silica catalyst at 750° Fahrenheit to verify this method. It was observed that the initial rate of reaction increased with pressure up to a pressure which was equivalent to a fugacity of 85 atmospheres of butanol-1 and thereafter decreased with increasing pressures.

Based on the postulated theory and the experimental observations, it was found that the rate of the surface reaction was controlling. This relationship may be theoretically expressed as follows:

$$r_o = \frac{(k_3) [C_f]_A (f_A)}{\left[ 1 - [C_f]_A (f_A) \right]^2} \quad (38)$$

where  $r_o$  is the initial heterogeneous reaction rate in (#mols)/(hr.)(# catalyst).

$k_3$  is the proportionality constant for the forward reaction

$[C_f]_A$  is the adsorption-equilibrium constant for component A on the catalyst surface in reciprocal atmospheres.

$f_A$  is the fugacity of component A (butanol-1) in atmospheres.

From the experimental data and the above assumptions the adsorption-equilibrium constant,  $[C_f]_A$ , for butanol-1 on an alumina-silica catalyst at 750° Fahrenheit was found to be:

$$1.2 \times 10^{-2} \text{ atmospheres}^{-1}$$

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#### THE EFFECTS OF FLUID PROPERTIES ON BOILING COEFFICIENTS

(Publication No. 3538)

John Earle Myers, Ph.D.  
University of Michigan, 1952

Data were taken during the operation of a pilot size horizontal shell and tube heat exchanger which permitted the determination of boiling coefficients on the external surfaces of the tubes.

There were four active tubes in the bundle, these being aligned in a vertical row on 1 1/2 inch centers. The tubes were of copper and had nominal dimensions of 3/4 inches outside diameter and 36 inches length. Hot water flowing through the tubes supplied the heat necessary to boil the various refrigerants used in the shell side of the exchanger.

Two different tube bundles were used — one consisting of plain copper tubes and the other of low finned copper tubes averaging 19 1/2 fins per inch of tube length. For each bundle, boiling coefficients were obtained using five different refrigerating fluids on the shell side. These fluids were Freon 12, n-butane, propane, methyl chloride and sulfur dioxide.

For each fluid with the two bundles experimental runs were made covering heat loads ranging from 1000 to 18,000 B. T. U. per (hr.)(ft.<sup>2</sup> of outside area) for the finned tubes and from 5000 to 38,000 B. T. U. per (hr.)(ft.<sup>2</sup> of outside area) for the plain tubes. For every combination of a particular fluid and tube bundle, data were taken at two and whenever possible, three temperature levels and the boiling coefficients were plotted as functions of the temperature drop across the boiling film.

An empirical equation representing the relationship between the boiling coefficient  $h_b$  in

B. T. U. per (hr.)(ft<sup>2</sup>)(° F) and the temperature drop  $\Delta t_b$  in ° F may be written as follows:

$$h_b = m \Delta t_b^n$$

When the experimental results obtained on the bottom tube, at the principle temperatures, were expressed in the form of this equation, the following values of the constants m and n were determined:

Refrigerant	Plain Tubes			Finned Tubes		
	Temp.	m	n	Temp.	m	n
Freon 12	47° F	0.59	2.70	55° F	61	1.25
Methyl Chloride	48	0.77	2.75	48	56	1.17
Sulfur Dioxide	56	0.48	2.58	55	96	0.77
n-butane	70	12.1	1.63	57	24	1.80
propane	38	51	1.46	40	110	1.16

On the basis of boiling coefficients determined for the bottom plain tube, a dimensionless equation has been proposed relating the fluid properties and temperature drop over the boiling film to the boiling coefficient. For the fluids Freon 12, methyl chloride and sulfur dioxide the equation is:

$$\frac{h_b}{k} \sqrt{\frac{\sigma}{\rho L}} = 3.40 \times 10^6 \left( \frac{k t_b}{L} \right)^{2.75}$$

For propane the equation is:

$$\frac{h_b}{k} \sqrt{\frac{\sigma}{\rho L}} = 2.80 \times 10^4 \left( \frac{k t_b}{L} \right)^{1.41}$$

The data for normal butane were not considered to be sufficiently stable to warrant a special equation although they are fairly well represented by the equation for Freon 12, methyl chloride and sulfur dioxide.

The effect of vapor from the bottom tube on the boiling coefficients of the tubes above has been investigated and supplementary equations proposed for determining the coefficients on these tubes. An additional factor discussed is the effect of conditioning of the boiling surface on heat transfer performance.

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## ENGINEERING, CIVIL

### THE ANALYSIS OF CONTINUOUS HIPPED-PLATE STRUCTURES

(Publication No. 3460)

Abdul-Karim Ahmed Ali, Sc. D.  
University of Michigan, 1952

In the development of the ordinary analysis of continuous hipped-plate structures, many unverified assumptions were made, since there was no experimental evidence or rigorous proof to substantiate some of these assumptions. The purpose of this investigation is to study the structural action and to validate the analytical solution for continuous hipped-plate structures with and without internal bracing.

Several experimental investigations were conducted on an aluminum model of a continuous hipped-plate roof of two spans to provide adequate information on the structural action of the roof and the importance of the various assumptions used in analytical solution. The tests were made in three parts:

1. the model without intermediate diaphragms;
2. the model with intermediate diaphragms in one span only; and
3. the model with intermediate diaphragms in both spans.

The discrepancy between the stresses obtained from the test on the model without intermediate diaphragms and the ordinary analysis of continuous structures is found to amount to as much as 200 per cent and even more at some points. This discrepancy is primarily due to the fact that in the present analysis, the change in the configuration of the cross section of the structure was neglected. A modified method of analysis which considers the effect of the cross section distortion in continuous structures is presented in this paper. It is found that the stresses at the interior supports are more affected by the distortion of the cross section than any section in a continuous structure loaded at all spans.

In the case of continuous hipped-plate structures with intermediate diaphragms, the tests show that the stresses approach a straight-line distribution across all the sections in the structure, providing that the spacing of the diaphragms is sufficiently close that the distortion of the cross section between the diaphragms can be neglected. A general solution for this condition is given in the dissertation.

The result of the test on the model with diaphragms in one span only shows that the distortion of the cross section in the span which lacks the intermediate diaphragms is very significant, and it changes the distribution of the stresses at the interior support materially.

The distortion of the cross section usually causes higher stresses at certain points in the structure; therefore, it is recommended that transverse stiffening ribs be utilized to minimize this distortion. An analytical method is developed in the dissertation to include the effect of the stiffening ribs. It is shown that in many cases the structure with transverse stiffening ribs has several advantages over the structure with or without solid intermediate diaphragms.

Several examples are solved to illustrate the different methods of analysis. The results obtained by applying the different methods are also checked against the experimental results. The theoretical results obtained by the method of analysis proposed in the dissertation agree much better with the experimental data than do the results of the ordinary method of analysis.

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## ENGINEERING, ELECTRICAL

## THE PROPAGATION OF ELECTROMAGNETIC WAVES IN A MAGNETRON-TYPE SPACE CHARGE

(Publication No. 3473)

George Raymond Brewer, Ph.D.  
University of Michigan, 1952

The propagation of electromagnetic waves in a magnetron-type space charge is studied by using small-signal, non-relativistic approximations. The following cases are analyzed:

## 1. Plane Magnetron —

- a. Propagation of a plane electromagnetic wave in a direction parallel to the applied magnetic field.
- b. Propagation of a plane electromagnetic wave in a direction perpendicular to the applied magnetic field and normal to the anode and cathode.
- c. Propagation of a plane electromagnetic wave of phase velocity slow compared to that of light in a direction perpendicular to the applied magnetic field and parallel to the electron drift motion.

## 2. Cylindrical Magnetron —

- a. Propagation of a TEM-type electromagnetic wave in a cylindrical space charge in a direction parallel to an axially applied magnetic field.
- b. Radial propagation of a cylindrical electromagnetic wave in a cylindrical space charge.

The analysis yields values for the propagation constant of the wave in the space charge, expressed in terms of an effective dielectric constant, which depends on the ratio of the signal radian frequency  $\omega$  to the cyclotron radian frequency  $\omega_0$  ( $= eB_0/m$ ). It is found that this effective dielectric constant can assume any real value, positive or negative. For given  $\omega/\omega_0$ , this knowledge of the effective dielectric constant makes possible the determination of the reactive effects of the space charge on a confining circuit.

The influence of the space charge on the frequency of a multi-anode magnetron is discussed qualitatively, as is the possibility of amplification of an electromagnetic wave along the plane magnetron space charge. Several experiments, conducted to determine the validity of the theory, are described. The results of these experiments appear to confirm certain critical parts of the theory.

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## DYNATRON OSCILLATOR OPERATION WITH PARTICULAR EMPHASIS TO A NEW SAW-TOOTH CURRENT OSCILLATOR

(Publication No. 3499)

Lawrence Joseph Giacoletto, Ph.D.  
University of Michigan, 1952

In the past, the dynatron oscillator has been employed principally to generate sine wave signals. Reports in the published literature have indicated that under some conditions a dynatron will generate signals of non-sinusoidal wave shapes. The non-sinusoidal mode of operation has not been studied extensively. This dissertation represents a detailed investigation of the dynatron. Particular attention is paid to the non-sinusoidal mode of operation with the objective of developing a circuit which will efficiently produce large amplitude saw-tooth currents through an inductor.

A direct analysis of a dynatron is complicated by the non-linear nature of the dynode characteristic. The characteristic may be assumed to be linear, but the results are then of limited validity. A better approximation for the dynode characteristic is to assume that it is composed of several linear portions. A solution for each linear portion is then readily possible. By matching boundary conditions at the extremes of each linear portion, a composite solution can be obtained.

Such a composite solution is obtained for a fundamental linear-power-transfer circuit which is closely related to the dynatron and similar energy exchange devices. The circuit consists of a linear-power source, a perfect switch, and energy storage and conversion elements. The switch is alternately opened and closed. The circuit voltages and currents are determined by matching boundary conditions at both ends of the switching interval. The validity of the analysis is checked by comparing the mathematical solutions with measured voltages and currents of a practical embodiment of the linear-power-transfer circuit.

The solutions of the linear-power-transfer circuit are used to study dynatron operation by drawing an analogy between a secondary-emitter tube and a perfect switch. Using this analogy, secondary-emitter-tube circuits, both separately and self-excited, are examined qualitatively and quantitatively. For the separately excited circuit, novel applications of secondary-emitter tubes for frequency division and multiplication are mentioned. A reason why Class C amplifiers may have output voltages whose peak value exceeds the battery voltage is indicated. The qualitative operation of a dynatron free of the usual small signal restrictions is developed. For certain regions of operation quantitative results are possible. The reasons for poor output voltage wave shape and frequency stability are examined, and an improved dynatron circuit is presented which largely overcomes these difficulties. The dynatron and the Class C oscillator are compared qualitatively.

The use of a secondary-emitter tube to produce saw-tooth current oscillations is examined in some detail. By analogy with the fundamental linear-

power-transfer circuit, the exact mode of operation is determined. With the operation of the circuit understood, several improvements are introduced which make possible large amplitude saw-tooth current oscillations with good efficiency. Equations are developed for the operating frequency in terms of circuit and tube parameters. These equations permit a detailed evaluation of circuit performance. Several practical matters are considered concerning the application of the saw-tooth current oscillator to magnetic deflection of electron beams.

Finally, the design and characteristics of several secondary-emitter tubes, developed for the applications herein considered, are presented.

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#### A METHOD FOR CHANGING THE FREQUENCY OF A COMPLEX WAVE

(Publication No. 3518)

Earle Lewis Kent, Ph. D.  
University of Michigan, 1952

The purpose of the research reported in this dissertation is to determine the characteristics, and the practical possibilities, of a method for changing the fundamental frequency of a periodic complex wave while retaining its wave form. The method proposed by the author utilizes electronic circuits for its operation and is limited to frequency reduction. Changing the frequency of a complex wave in a continuous sense has not previously been possible by electronic means if the resultant wave is required to retain the harmonic content, or wave form, of the original wave.

An analysis of the problem is given indicating the usefulness of such a frequency changer, the requirements, and the general limitations associated with frequency transformation.

A mathematical presentation of the proposed method shows it to be theoretically sound and reveals its limitations. The limitations of accuracy and range of operation are found to be favorable and allow the method to be useful in a number of practical applications. In addition to being limited to frequency reduction, the system has one other general restriction. It is limited to cases where the highest harmonic present in the resultant wave is less than one-half the frequency of the fundamental of the original complex wave.

Various means for applying the proposed frequency changer principle are given. Experimental results are presented for a changer using a special cathode-ray tube and two other means, using ordinary radio-type vacuum tubes, are described. The circuits presented are not particularly complex nor do they involve uncommon apparatus for their operation.

Brief descriptions are given for applications of the frequency changer method in a tone synthesizer, a musical instrument and a harmonic analyzer.

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#### THE INSERTION MAGNETRON: A NEW EXTERNAL-CAVITY MAGNETRON FOR LOW-POWER ELECTRONICALLY-TUNABLE OPERATION IN THE 10 TO 20-CM WAVELENGTH RANGE

(Publication No. 3540)

Jules Sid Needle, Ph. D.  
University of Michigan, 1952

This is a study of the design, construction and performance of a new type of low-power, external-cavity multianode magnetron for operation in the 10 to 20-cm wavelength range. The basic structure of this new magnetron consists of a short hermetically-sealed section of coaxial transmission line which can be used with an external cavity. The sealed-off section contains a multianode structure consisting of six equally spaced radial vanes extending from the inner wall of the outer coaxial cylinder into six longitudinal slots in the inner coaxial cylinder. The cathode is symmetrically located within the inner coaxial cylinder at the position of the multianode structure. This sealed-off structure is used to excite a TEM mode in an external coaxial circuit.

Special attention was given to the problem of wide-range tunability using either mechanical or electrical methods. Design equations for a mechanically-tunable coaxial-line resonator were derived and were utilized in the design and construction of a prototype resonator.

Experiments were performed with the following objectives:

a. to determine the feasibility of operating the insertion tube as a mechanically-tunable magnetron over a wide range of wavelengths.

b. to find out whether or not wide-range electronic tuning could be attained with this tube and its associated circuitry and to determine the limiting factors in this type of operation.

c. to determine the effects of the circuit on upper-mode-boundary current and on frequency pushing.

Mechanically-tunable operation from 9.8 to 13.8 cm was attained and a tunable range from 10 to 20 cm was indicated.

Electronic tuning from 14.66 to 17.75 cm was attained and a range from 11 to 18 cm was indicated. Excess noise and low available power were found to be the limiting factors in this type of operation.

Experimental observations on upper-mode-boundary current and frequency pushing were obtained and were interpreted in terms of computed circuit properties.

It is concluded that, although this structure is not now of commercial value as a tunable, low-power, microwave generator, it can be developed to this point within the foreseeable future.

Microfilm copy of complete manuscript of 166 pages, \$2.08. Enlargements 6" x 8", 10¢ per page.

**ENGINEERING, MECHANICAL****AN ANALYSIS OF THE EFFECT OF VARIOUS FACTORS ON METAL TRANSFER AND WEAR**

(Publication No. 3493)

I-Ming Feng, Ph. D.  
University of Michigan, 1952

The purpose of this dissertation is to analyze the effect of various factors on metal transfer and wear based upon a new theory of metal transfer and wear proposed by the author, and to yield experimental support for the proposed new theory.

The proposed new theory of metal transfer and wear is summarized as follows: Metal transfer between two rubbing surfaces is due primarily to the mechanical interlocking of the roughened interfaces of the actually contacting spots as the result of plastic deformation, and secondarily to the adhesion or the diffusion which takes place during the temperature flash caused by the breakage of the mechanically interlocked contacting spots. When the diffusion process is not rapid and the adhesive force is weak, the broken metallic blob falls off as a loose wear particle, instead of becoming a piece of transferred metal.

Based upon the proposed new theory, the effects of the following factors on metal transfer and wear are discussed qualitatively: (1) normal load, (2) sliding speed, (3) average temperature of the bulk metal, (4) distance of travel, (5) elastic limit, (6) Young's modulus of elasticity, (7) Poisson's ratio, (8) crystal structure, (9) crystallographic orientation, (10) grain size, (11) grain orientation, (12) resoftening temperature, (13) hardness of the strain-hardened metal, (14) penetration of the strain-hardened region, (15) thermal conductivity, (16) specific heat, (17) rate of diffusion, (18) surface contamination, (19) roughness of the high spots, and (20) size and distribution of the high spots. A large number of the conclusions reached in the analysis are in good qualitative agreement with the experimental results reported by other investigators and cited by the author.

A special apparatus was designed and constructed which enabled the author to apply a tangential force to a pair of contacting cylindrical metallic specimens (with their axes parallel) which were kept under compression. The investigation of the intersection of the sectioning plane and the interface between the contacting cylindrical specimens which were kept under compression during the investigation was made with optical and electron microscopes, before and after the application of the tangential force.

The author's experimental results show the roughening of the interface, the perfect matching of the roughened interfaces which give strong mechanical interlocking, a definite region of severely strain-hardened metal near the interface, and the initiation of breakage near the boundary of the severely strain-hardened region under the application of a tangential force. These experimental

results support the proposed hypotheses concerning the processes which lead up to the result of metal transfer and wear.

Microfilm copy of complete manuscript of 191 pages, \$2.39. Enlargements 6" x 8", 10¢ per page.

**ENGINEERING, METALLURGICAL****THE INFLUENCE OF LARGE SOLUTE ATOMS ON THE CRYSTALLOGRAPHIC TEXTURE AND CREEP PROPERTIES OF WROUGHT Cr-Ni-Co-Fe-Mo-W-Cb ALLOYS**

(Publication No. 3483)

Clark Lawrence Corey, Jr., Ph. D.  
University of Michigan, 1952

A limited investigation of the influence of additions of large solute atoms on the creep characteristics of an alloy mainly dependent on matrix characteristics for creep properties was carried out using additions of molybdenum, tungsten, and columbium to a 20 Cr-20 Co-20 Ni-40 Fe alloy. This dissertation may be divided into three main phases: (1) the measurement of mosaic block sizes and random atomic displacements — parameters through which the solute atoms may exert their chief influence on flow; (2) determination of flow properties; (3) development of a theoretical basis for discussing the creep properties of the alloys.

The additions of increasing amounts of the large solute atoms generally decreased the mosaic block sizes, but the effect reached a minimum, after which the sizes increased with the addition of the incongruous solute atoms. Random atomic displacements, resulting from the stress fields surrounding incongruous atoms, increased with the number of solute atoms. The determination of these two parameters was made from measurements of the integrated intensity of the X-ray diffraction lines.

The influence of the large solute atoms on creep characteristics was both stress and temperature dependent and also differed from low to high levels of concentration of solute atoms. Creep tests were conducted at 1200° F and 1500° F, and stresses were chosen at each temperature which would permit a wide range of creep rates. For low stresses at 1200° F the first additions of the large solute atoms increased the creep rate, but as the concentration of solute atoms was increased the rate of decrease of the creep rate was reduced. The creep rate, for the tungsten modifications, was reduced at the highest concentration of tungsten. The creep rate was always reduced by the addition of the incongruous solute atoms for high stresses at 1200° F and for all stresses at 1500° F.

A theoretical analysis based on the rate of generation and rate of flow of dislocations qualitatively accounts for the creep behavior observed. For low stresses at 1200° F the creep strengths pass through a minimum (at least for the tungsten

alloys) as do the mosaic block sizes. It has been postulated that this behavior was due to two inter-related factors: (1) the rate of generation of dislocations controls the creep strength at low stresses and below a certain temperature for any given alloy and (2) dislocations are initiated predominately at mosaic boundaries, the smaller the mosaic blocks the larger the source area and the greater the rate of formation of dislocations. At higher stresses or higher temperatures the rate of flow of dislocations appeared to control the creep rate. Random atomic displacements produced by the solute atoms was considered to be the factor determining the rate of flow of dislocations.

Lattice parameter measurements and metallographic studies were made to determine the extent and effect of precipitation on the flow properties. It was concluded that the loss of the large solute atoms from solution was not appreciable at 1200° F; at 1500° F there probably was a precipitation of solute atoms during testing, however the consistent increase in creep strength with the addition of solute atoms was assumed to mean that the number of solute atoms retained in solution during testing was directly related to the number initially present.

Microfilm copy of complete manuscript of 136 pages, \$1.70. Enlargements 6" x 8", 10¢ per page.

## ENGINEERING MECHANICS

### AN INVESTIGATION OF THE PUNCHING OF MEDIUM-CARBON STEEL

(Publication No. 3480)

Samuel Kelly Clark, Ph. D.  
University of Michigan, 1952

This investigation was performed to describe the phenomena which arise when a circular flat-headed punch is driven into and through a sheet of medium carbon steel.

Stress-strain relations for steel in regions of high strain are used to formulate an expression for the force  $F$  acting on the punch at any penetration  $p$  of a sheet of metal, in the form

$$F = \pi D t \left(1 - \frac{p}{t}\right) \left[ \frac{a}{\sqrt{3}} + \frac{b}{\sqrt{3}} \ln\left(\frac{2}{\sqrt{3}} \frac{1}{\xi} \frac{p}{t}\right) \right]$$

where

$D$  = punch diameter

$t$  = thickness of metal being pierced

$\xi$  = width of deformed annulus of metal  
and where "a" and "b" are material constants  
which may be determined by a single laboratory  
piercing test.

Thermal effects during piercing are treated theoretically, from which calculations are performed showing that the heat generated, at least in high speed piercing, is sufficient to bring that portion of the metal adjacent to the punch to temperatures high enough to change the material properties.

Photographs of etched diametral sections of progressive partial piercings are given, enabling

one to describe the process of piercing in terms of metal flow and fracture. The effect of fractures during piercing is measured, and this result used to modify the theory previously developed.

Curves of force vs. penetration are obtained for forty different combinations of metal thickness and die diameter in a standard screw type testing machine at a punch velocity of .005 inches per minute. The work done by the punch as it progresses down through the metal, that is, the area under the curve of force vs. penetration, is found to be a linear function of the ratio of clearance between punch and die to metal thickness.

Photographic curves of force vs. penetration are presented for twelve cases in which punch velocity at impact varies from 2.6 to 17.9 inches per second with accompanying variations in kinetic energy. These were obtained by a mechanical method employing DeForest scratch type recording strain gauges. The curves are similar in shape to those obtained from the slow speed tests, but the magnitude of the forces involved is roughly 2/3 as great, an effect which is explained by the increase in temperatures generated by energy dissipation in the form of heat.

Measurements made of the diameters of holes pierced with a single punch and dies of varying sizes shows that hole size increases slightly with increasing button-die size, but the relation is not linear. Curves for this are presented.

The principal conclusions which may be drawn from this investigation are: (1) the forces acting on a punch, and the work done by it in piercing, may be predicted with sufficient accuracy by theoretical considerations, (2) fracture and heat transfer play important, but as yet not fully defined, roles in piercing, (3) the work done during piercing is a linear function of clearance between punch and die, and (4) forces arising in high speed piercing are less than those observed in identical tests at low values of punch velocity, a fact which must be explained by the effect of the high temperatures generated on the properties of the material being pierced.

Microfilm copy of complete manuscript of 153 pages, \$1.91. Enlargements 6" x 8", 10¢ per page.

## EXPERIMENTAL INVESTIGATION OF COLUMN ACTION AFTER BUCKLING

(Publication No. 3512)

Thomas Alexander Hunter III, Ph. D.  
University of Michigan, 1952

This work is the result of an experimental investigation of the post-buckling action of pinned end mild steel columns under constant axial compressive deformation rate. It is based on the determination of the axial load carrying capacities of sixty specimen bars of round and square cross section, which were tested to two per cent axial deformation.

Quantities measured include axial load, axial deformation, maximum axial load, specific energy dissipation, modulus of elasticity during unloading, and the values of unit axial loads for certain unit axial deformations. Slenderness ratios varied from 20 to 160. An attempt was made to verify a limit design column formula published by Van den Broek, known as formula IX.

Results are given in the form of curves which show the variation of the unit axial load with the unit axial deformation. Parts of the results provide verification of theories proposed by others and indicate means of calculating loads in redundant frameworks.

Conclusions indicate that Van den Broek's formula IX is not susceptible to experimental verification, and may be reasonably approximated by a straight line relationship within the usual useful slenderness range of steel columns. Specific energy losses and modulus of elasticity during unloading may be represented by simple empirical relationships.

Microfilm copy of complete manuscript of 54 pages, \$1.00. Enlargements 6" x 8", 10¢ per page.

## FINE ARTS

### THE RESTORATION OF THE "NEREID" MONUMENT AT XANTHOS

(Publication No 3432)

Carla Gottlieb, Ph.D.  
Columbia University, 1951

The "Nereid" Monument at Xanthos, discovered in 1838 and excavated in 1842 by Fellows, and subsequently investigated by Niemann in 1881, remains in situ only with respect to the limestone substructure. The marble members of the superstructure, including four sculptured friezes, were shipped by Fellows to London and are at present stored in the Underground. They belong to two elements: (1) a high podium in the Ionic building tradition supporting (2) a peristylar temple-like building.

The marble podium was probably six courses in height, including two friezes and an egg-and-dart crown. The evidence shows that it was constructed in pseudo-isodomic masonry, likewise characteristically Ionian, the broader frieze at its foot, the narrower at the top under the crown. The restoration of the egg-and-dart establishes that the second and fifth flank columns were located on joints, and that the basic rectangle (outer column faces —Vitruvius III, 3, 7) was accurately proportioned as 2:3. The limestone substructure was apparently solid.

The peristyle of 6 x 4 columns was crowned by a sculptured epistyle and by a cornice with dentils 0.1905 m. high. The front columns were spaced at equal distances without the usual Ionic widening of the central intercolumniation. All columns were vertical. The normal intermediate tiles were of

the standard width and length, 0.638 m. by 0.793 m. The pteroma was equal in width on all four sides of the building, the ceiling coffers reaching from epistyle to cella frieze.

The length and width of the cella and its course jointing can be recovered. It had prodomos and opisthodomos, without columns in-antis. Analogies suggest that the cella was square, the porches equal in depth. The front was closed by a grille. The anta capitals can be accurately assigned to their respective corners. Two were two courses in height, the additional joint disturbing the cella frieze jointing on that flank. The cella wall, coursed in pseudo-isodomic masonry (like the podium) in a regular alternation of orthostates and plinths, twelve courses in all including frieze, had a wall base and epikranitis. The door opening had lintel and cornice, separated by a frieze, flanked by one-sided volutes. It corresponded to two cross-wall stones in width and to eight wall courses in height, the lintel plus frieze aligning with two courses, the cornice with one. It was closed by marble leaves, a fragment of which was perhaps the "triple-trough" seen by Fellows' sailors.

The sequence of the four friezes can be restored leaving room for doubt only in the placement of a few slabs, and even these could in all probability be located by study in London. The distribution of the free-standing sculpture, however, must remain conjectural until corroborated by study of the statue plinths, matching them with the mortises on the stylobate slabs, as now located. The following solution has been tentatively adopted: a chorus of maidens in the intercolumniations, the rape groups as central and the lions as corner acroteria, the male and female statues and the sphinx in the interior.

In technique, the most interesting detail is the co-existence of "T" clamps for major and of hook clamps for minor duty. The foot unit derived from the lower column diameter (0.368 m. = 1 1/4 Ionic Feet) is 1 Ionic Foot = 0.3944 m. The architectural design, technical details, and sculptural style concur to indicate a date of 415-410 B.C., and some Ionian architect who, however, studied Periclean architecture at its source.

The monument was a tomb. Its novel design, combining the three traditional features of Xanthian tomb architecture, viz., height (pillar tombs), temple-like exterior (rock-cut tombs) and burial chamber raised upon a pedestal (sarcophagos tombs), served as source of inspiration for the Mausoleion, which in its turn added a fourth element to the design — a pyramid; and through this medium, but in its revised form, it exercised an enormous influence upon subsequent architecture.

Microfilm copy of complete manuscript of 405 pages, \$5.06. Enlargements 6" x 8", 10¢ per page.

## FORESTRY AND CONSERVATION

**A DETERMINATION OF THE RELATIONSHIP  
BETWEEN CERTAIN SOIL MOISTURE  
CONDITIONS AND THE DEVELOPMENT  
OF SEEDLINGS OF SOME FOREST TREE SPECIES**

(Publication No. 3464)

Osman Adly Badran, Ph. D.  
University of Michigan, 1952

In this study of the effects of certain soil-moisture conditions upon the development of plants, forest tree seedlings were used instead of the herbaceous species employed by most previous investigators in this field. Another innovation was the measurement of soil-moisture by means of the electrometric method of Bouyoucos and Mick.

Seedlings of honey locust, American elm, Monterey pine, Douglas fir, Norway spruce, and white pine were each grown on five soil types that varied from clay to sand. Mechanical and chemical analyses and determinations of their water holding capacity, moisture equivalent, field capacity, hygroscopic coefficient and content of organic matter were made for each of the soil types. Sunflower seedlings were also grown on all of the soil types, so that their behavior might be compared with that of the tree seedlings.

One major object was to determine the wilting coefficient of the various soils at the point that permanent wilting occurred in each of the different species of plants grown. The results obtained indicate that the wilting coefficient is affected not only by the soil texture but also by the species of plant grown on a particular soil type. The differences in the amount of water remaining in a given soil at the time that permanent wilting occurred in each of the species of plant were large in the case of soils of fine texture and decreased as the texture of the soil became coarser. On the basis of their relative ability to deplete the amount of water left in the soil at the time of permanent wilting, the species rank in ascending order, as follows: sunflower, Norway spruce, honey locust, white pine, American elm, Monterey pine and Douglas fir.

Data obtained on the daily rate of moisture extraction from the soil by the indicator plants show that it is related to the transpiring areas of the shoots throughout the range of available moisture — from field capacity to the wilting point. The amount of transpiration per unit area of leaf-surface seemed, however, to be related to the shoot-root ratio.

The wilting symptoms of the different species, as shown by morphological changes, were carefully observed and descriptions of these are given.

In the case of three species of the indicator plants, data were obtained on the influence of soil-moisture changes on the daily rates of elongation in stems and leaves. Such elongation was found to cease before the moisture in the soil had been reduced to the wilting point, and the difference between the per cent of moisture at which growth

stopped and that present at the time of wilting varied with species of plant and with soil type.

Comparative observations of the available soil-moisture made by the use of the Bouyoucos "moisture meter" and the Wheatstone bridge showed that the "moisture meter" is just as satisfactory for practical purposes as the Wheatstone bridge and has the advantage of being more compact and more convenient to use in the field.

Microfilm copy of complete manuscript of 174 pages, \$2.18. Enlargements 6" x 8", 10¢ per page.

## GEOGRAPHY

**MONTERREY, MEXICO: A STUDY IN URBAN  
GEOGRAPHY**

(Publication No. 3474)

Martin Eugene Brigham, Ph. D.  
University of Michigan, 1952

Monterrey, capital of the State of Nuevo Leon, in northeast Mexico, has experienced two phases of development. The first phase dates from the founding of Monterrey, in 1596, until approximately 1890, a span of 294 years. This period is characterized by a small, isolated and provincial market town. The second phase of development, from 1890 until the present, is entirely different from the first. It is characterized by a large industrial city. These facts suggest a problem. What are the causes for Monterrey's transformation, from a small town to a modern metropolis? This study seeks to determine the causes of change, by investigating the main elements of Monterrey's urban geography.

The procedure for conducting this inquiry is not complex. Attention is first given to Monterrey's regional setting. The focus of attention then narrows to the site of Monterrey, and to the present day urban functions of the city. Monterrey's population is considered in detail, as population is the best index for judging urban growth. Population is studied from the first settlement until the present, noting the periods of growth, the relationship of population to urban land use, and the qualities of the people.

Monterrey's population increase is more the effect than cause of urban growth. The causes are found in the areas in which Monterrey has special prominence; namely as a transportation, manufacturing and tourist center. These functions are considered in detail, as they explain Monterrey's urban growth since the turn of the century. Improved transportation facilities, in railways, highways and airways, stimulated economic activity in agriculture, mining, industrial development and tourist trade. Monterrey's population increase results from this economic expansion. Today the city is the dominant regional urban nucleus of northeast Mexico, third largest Mexican city, and second most important communication center in the country. It has

been a Mexican pioneer in industrial development and tourist trade.

In conclusion, the rise of Monterrey is an outstanding example of recent progress in Mexico, of social advance through urban growth. Three basic factors explain the city's modern growth: (1) The focusing of major trade routes at Monterrey made the city the control point for northeast Mexico, and a gateway for trade relations between Mexico and the United States. (2) Monterrey's proximity to the United States has resulted in vital American contributions to the city's growth. These include capital and technology, for transportation and industrial development, and tourists. The United States is the leading source of supply, and market, for Monterrey's foreign imports and exports. (3) The fusion of Mexican and American cultures, at Monterrey, has had a stimulating effect on the city's population. The people of Monterrey have a reputation, in Mexico, for energy, business ability and civic spirit. Modern Monterrey is a tribute to resourceful men, who created a new and better urban environment, from rather limited resources.

Microfilm copy of complete manuscript of 134 pages, \$1.68. Enlargements 6" x 8", 10¢ per page.

## GEOLOGY

### THE GEOLOGY AND GOLD DEPOSITS OF GOLDFIELDS, LAKE ATHABASKA, SASKATCHEWAN

(Publication No. 2911)

Arthur Paul Beavan, Ph. D.  
Princeton University, 1938

Abstract not available.

Microfilm copy of complete manuscript of 186 pages, \$2.33. Enlargements 6" x 8", 10¢ per page.

### THE STRATIGRAPHY AND MICROPALAEONTOLOGY OF THE CODY SHALE IN SOUTHERN MONTANA AND NORTHERN WYOMING

(Publication No. 2951)

Steven Knowlton Fox, Jr., Ph. D.  
Princeton University, 1939

Abstract not available.

Microfilm copy of complete manuscript of 242 pages, \$3.03. Enlargements 6" x 8", 10¢ per page.

### GEOLOGY OF THE HODGES HILLS-MARKS LAKE AREA, NORTHERN NEWFOUNDLAND

(Publication No. 3510)

John Jesse Hayes, Ph. D.  
University of Michigan, 1952

The Hodges Hills-Marks Lake area lies northeast of the town of Badger in northern Newfoundland between the southwestern coast of Notre Dame Bay and the Exploits River. The main rock types are folded and faulted Ordovician volcanic and sedimentary rocks, intruded by granite, granodiorite and diorite of probable Devonian age. These rocks were eroded by at least one major phase of continental glaciation during which the ice moved northeastward. A mountain glaciation phase followed continental glaciation and is recorded in the vicinity of the Hodges Hills.

The oldest rocks in the area are those of the Wild Bight formation and consist chiefly of andesite agglomerate, tuff and flows. The Sansom formation, which made up mainly of arenaceous and conglomeratic rocks together with minor amounts of shale, overlies the Wild Bight formation, but the two units are separated by a minor disconformity. The Sansom grades upward into the Sivier formation by an increase in the proportion of agrillaceous to arenaceous rocks, such that the Sivier is composed mostly of shale and fine-grained sediments. The Crescent Lake formation overlies the Sivier and contains large amounts of red and green chert and variously coloured shale. The Crescent Lake rocks are conformably overlain by an assemblage of basalt pillow lavas containing interstitial red chert, massive basalt flows and numerous tuff beds termed the Breakheart formation. These formations have many features in common with rocks in the Bay of Exploits, New Bay and Pilley Island areas to the northeast and east and are considered part of the Exploits series of southern Notre Dame Bay.

Large bodies of granite and diorite were intruded into the Exploits series during the period following initial regional deformation, but prior to major faulting.

The area has been subjected to intense regional compression. As a result, close-folding, overturning and faulting of the bedrock has occurred on a major scale. The majority of the axial planes of folds and the faults dip steeply eastward. The northwestern sides of faults are commonly downthrown. Most of the deformation is considered to be Caledonian in age but some of the earlier effects may have been due to Acadian orogenesis. Additional movement along major fault planes probably occurred during the Appalachian Revolution.

One deposit of massive pyrite was discovered at Kippins Pond in the northern part of the area. The pyrite replaces a grey rhyolite flow in isoclinally folded beds of the Sivier formation along a zone of major faulting that strikes northeast. The Kippins Pond deposit lies between the Gull Lake copper deposit west of the map-area, and the pyrite-copper sulfide deposits on Pilley Island

northeast of the map-area. The extent of the sulfide body at Kippins Pond is unknown, but it has several features in common with the deposit at Gull Lake.

Microfilm copy of complete manuscript of 260 pages, \$3.25. Enlargements 6" x 8", 10¢ per page.

## HISTORY

### MYSTICISM AND ITS EFFECT ON THE ATTITUDE TOWARDS LITERATURE AND LEARNING IN THE FORMATIVE YEARS OF MONASTICISM

(Publication No. 3470)

John Everett Bingley, Ph. D.  
University of Michigan, 1952

The purpose of this study is to determine whether or not a productive attitude towards learning and literature was prevalent in monasticism in its formative years, particularly in Egypt and in the West before Cassiodorus. It attempts to determine classes of literature and the monastic attitude towards them and attempts to demonstrate that beginning with Anthony and Pachomius, the founders of monasticism, there were already established diversified attitudes towards learning which found their unity in a mystic theory of knowledge.

The first three chapters are concerned with monasticism as a mystic, charismatic organism to which a man bound himself by a vow in order to seek two kinds of knowledge, Practical Knowledge and Spiritual Knowledge.

Chapters four through eight are concerned with the literature necessary to Practical Knowledge and the monastic attitude towards it. Two classes of literature and two attitudes toward them were determined. One class of literature, full and complete, taught ethical or Practical Knowledge. It was the literature which taught monasticism purity of mind. It was avidly studied and read and included in it before the time of Benedict were all the genre necessary for that end. Another class of literature, never explicitly mentioned, was dependent upon the "gifts" which the mystic theory stated God granted in order to bring the virtues to perfection. The "gifts" of teaching, healing, almsgiving, etc. demanded a literature, and, although the mystic theory quite plainly stated in the documents that the "gifts" were granted through the learning of no man, some amount of study and learning, as well as a literature, was necessary in order to bring the "gifts" to perfection.

Chapters nine through twelve are concerned with Spiritual Knowledge, a knowledge which the mystic theory adhered to in monasticism claimed could not be taught since it came only through Illumination of Scripture. Beneath that theory, however, monasticism showed that it had a need for a literature and a lively attitude towards it. The need to avoid heresy, the close and intimate relationship to the bishops, and above all, the desire for a true

and orthodox Illumination caused monasticism from its inception to encompass the whole body of Catholic doctrine and writing as well as a small body of classical works.

The conclusions which may be drawn from this study are as follows: (1) The motivating force behind monasticism, mysticism, engendered an attitude towards learning and literature. (2) Four distinct attitudes and classes of literature existed in monasticism in the formative period: (a) An earnest and studious attitude, wholly ascetic, towards that literature which taught the moral purity necessary for purity of mind. (b) An ascetic and contemplative attitude towards that literature which aided the monks to formulate the "mystery" they wished to have Illuminated. (c) An unproductive, but ascetic, attitude towards that literature which aided the monks to fulfill the gifts of healing, teaching, almsgiving, etc. (d) An ascetic "christianizing" attitude towards those classical works which served as propaedeutics to the literature of Spiritual Knowledge.

Microfilm copy of complete manuscript of 508 pages, \$6.35. Enlargements 6" x 8", 10¢ per page.

### DON GASPAR DE QUIROGA: A STUDY OF HIS ECCLESIASTICAL AND INQUISITORIAL POLICIES IN SPAIN, 1572-1594

(Publication No. 3472)

Maurice Boyd, Ph. D.  
University of Michigan, 1952

The purpose of this study was to investigate the ecclesiastical and inquisitorial policies of Don Gaspar de Quiroga, archbishop of Toledo and inquisitor general of the Spanish kingdoms, during the years 1572-1594. In the 1570's, this industrious Spanish prelate introduced a program to broaden and reform the Catholic Church in Spain. Concurrently, he introduced a clearer and moderate policy in Spanish inquisitorial affairs.

The early Augustinian influences at Madrigal, the Spanish humanism absorbed during his school years at Salamanca and Valladolid, and the frequent association with an enlightened group of Toledan scholars and artists undoubtedly influenced Gaspar de Quiroga. After a few administrative indiscretions early in his career, Quiroga's superior moral character and excellent judgment won the attention of Philip II, who commissioned him to reform the Neapolitan and Sicilian monasteries. Following this assignment, Quiroga successively held the presidency of the Council of Italy and the bishopric of the Canaries prior to his elevation to the bishopric of Cuenca in 1572. While in Cuenca, Quiroga began his religious policies, which, when fully developed, became the nucleus of the Spanish religious reform in the latter half of the sixteenth century. Extending these policies when he became archbishop of Toledo and primate of the Spanish church, Quiroga produced a standardized Manual of the Sacraments

in an effort to gain uniformity in church worship. He took the first positive action in Spain to carry out the decrees of the Council of Trent at the Toledoan Council of 1581-1582. His clerical reforms touched on the morals of the clergy and the prohibition of gambling; his moralistic revival for the laity emphasized the veneration of saints and the return to Toledo of the remains of Santa Leocadia. Poetical writings and other literature extolling a system of values consonant with such a religious program were patronized by this archbishop. The erection of seminaries, convents, and colegios (secondary schools) formed part of the program to advance religious education in Spain.

This same interest in religious reform was carried into the top levels of the Spanish inquisition by Quiroga since he also held the inquisitor-generalship from 1572 to 1594. He and the General Council of the Inquisition undertook the delicate task of issuing the Edict of Grace to repentent and newly converted Moriscos. Quiroga established schools for the primary education and religious instruction of the Moriscos, deeming this the proper way to unify Spain in spite of racial divergences. The unedifying story of opposition in the lower inquisitorial offices, coupled with the indifference of the shortsighted Moriscos, led to the failure of an ambitious program that might have prevented or delayed the expulsion of the Moriscos from Spain in 1609.

The inquisitorial reorfrms of this period necessarily involved Quiroga in Spanish foreign policy. He advocated a truce in the Netherlands revolt in order to crush England, the true enemy of Spain. He liberally supported the king with funds for the Spanish Armada of 1588. He was not opposed to the annexation of Portugal, although he had to temporize with the papal nuncio over the matter.

Within Castile, Quiroga's inquisitorial machine was used as the testing ground for two Spanish intellectual groups. Several latitudinarian Augustinians, including Luis de Leon, Martinez de Cantalapiedra, and Gaspar de Grajal, were denounced for heterodoxy by Leon de Castro and other Salamanca scholastics. These cases, lasting for years in some instances, were never decided until Quiroga personally dealt with them. He dismissed the charges and thereby upheld the advocates of the "new scholarship."

Nevertheless, to help clarify the problems of heterodoxy, Quiroga pushed to completion the long proposed Spanish Index. It appeared in two parts — the indexed books and authors in 1583, and the expurgated works in 1584. This latter index, the first of its kind in Spain, was separately prepared at Quiroga's suggestion so that many works otherwise forbidden could appear after the objectional portion was deleted.

The question of papal jurisdiction over the Spanish inquisition was clarified somewhat by Quiroga. After his early years of service as a member of the Sagrada Rota Romana, he never questioned papal spiritual supremacy. He did question the Pope's jurisdiction in temporal and inquisitorial affairs in Sicily and Naples, and often

delayed action upon a papal decree until he could relay the impractical aspects of the decree back to Rome for a modified decision.

Quiroga cautiously extended Spanish inquisitorial jurisdiction as a civil instrument to help unify the Spanish empire. Unfortunately, he saw his policy overextended when Philip II used the inquisition as a purely civil instrument to convict Antonio Perez. The subsequent estrangement of Quiroga and Philip, aggravated by added military supervision over the inquisition in Aragon, left Quiroga a disillusioned man in the last two and a half years of his life. He died in November, 1594, well intentioned and charitable to the end, but only mildly successful in his reforms.

Microfilm copy of complete manuscript of 250 pages, \$3.13. Enlargements 6" x 8", 10¢ per page.

#### THE RISE OF THE AMERICAN PHILOSOPHICAL SOCIETY, 1766-1787

(Publication No. 3430)

Brooke Hindle, Ph. D.  
University of Pennsylvania, 1949

The scientific academy, as it developed in Europe during the seventeenth century, proved particularly effective in advancing and disseminating the scientific revolution. The Royal Society of London for Promoting Natural Knowledge was the most influential academy in the English-speaking world. It served as a platform for the earliest scientists of colonial America and as a model when they sought to erect an academy in America.

Attempts had been made to establish a learned society in the American colonies as early as 1683, but permanent success was not attained until just before the American Revolution. In 1769, two Philadelphia organizations were united to form the American Philosophical Society, held at Philadelphia, for Promoting Useful Knowledge. Almost immediately, it attained success at home and acclaim abroad. Its membership came to include almost everyone in the Philadelphia area with any pretensions to learning as well as numbers of the most influential political and social leaders of the city. Members were also drawn from the scientifically inclined of the other colonies, particularly from the southern colonies; and a handful of distinguished Europeans, most of them Britishers, seemed equally eager to accept membership. The organization of the society was completed with a display of tact and political acumen. Finances never ceased to be a problem, but the Pennsylvania assembly, the proprietary family, and the merchants of the city could always be counted upon to support the Philadelphia society.

From the outset, the society demonstrated interest in basic science as well as in its applications, completing one impressive project of each type before the close of the colonial period. Its observations of the transit of Venus in 1769 were

carried out at three different locations; they were analyzed and publicized in a manner that brought international recognition to the organization. Its survey of water and land routes to connect the Delaware River with the Chesapeake Bay was a wholly utilitarian project financed by the commercial interests. Both projects in company with papers on agriculture, medicine and other subjects were given a place in the first volume of *Transactions* issued by the American Philosophical Society in 1771.

With the coming of the War for American Independence, the enthusiasm which had led to such achievements declined and, for a time, meetings were given up altogether. Revivals were attempted before peace had been won but for a number of years no great success was met in recovering the colonial vigor and effectiveness.

The post-war society found itself confronted with very different conditions. Learned societies began to arise in other American cities and more specialized organizations were developed for the promotion of agriculture, manufactures, and medicine. As a result, the American Philosophical Society became more local and less utilitarian in its orientation. On the other hand, it was strengthened by the cultural nationalism which accompanied and followed the Revolution.

The accomplishments of this period were inferior to those of the colonial society. Nevertheless, constructive work continued with the issuance of a second volume of *Transactions* in 1786, the building of a hall to house the organization, the encouragement of exploration, the development of a premium program to promote scientific writing, and many other innovations. By the close of the confederation period, the society had attained a stable and well-defined position — it had an honored role to play in the new nation.

Microfilm copy of complete manuscript of 71 pages, \$1.00. Enlargements 6" x 8", 10¢ per page.

#### A SOCIAL HISTORY OF LEADVILLE, COLORADO, DURING THE BOOM DAYS, 1877-1881

(Publication No. 3163)

Eugene Floyd Irey, Ph. D.  
University of Minnesota, 1951

Leadville, one of the nation's great silver camps, is of importance as a frontier mining town which has lasted into the present and as an influence on Colorado history. It is with the first aspect that the present study deals, attempting by reference chiefly to available primary sources and newspapers of the period to determine the nature of this important boom town of the last century. The study is limited to the period of Leadville's history from its founding until it became well established community (1880).

Available material indicates that as the Leadville area grew from a camp of 300 population to a

city with an estimated population of over 40,000, most of whom were males under 35 years of age, major civic problems developed rapidly. Of these, those which could be met by individuals or groups of individuals were solved most successfully; those which were referred to the city government or its agencies were usually handled ineptly or not at all.

In the first category fall such considerations as business and transportation, housing, food, the press, and the churches. In every case considerable activity was shown. Businesses of all kinds were established and were profitable despite the inflation accompanying the increase in population and the difficulties of transportation. Beginning as a small cluster of log shanties, Leadville by 1880 had become a city of frame houses and imposing brick business buildings. It was represented by an active press. Many religious groups were present, each with its own church building and several engaged in providing charity and in supporting the city's hospitals. Lively entertainment from the lowest class brothel to the Tabor Opera House catered to all types. The professions were well represented, and Leadville had developed well defined social classes.

Those public utilities which could be provided by groups of citizens were likewise in successful operation. A water works was established, gas lights were in use, the telephone was introduced, and plans were under consideration for the installation of electricity. A horse-drawn street railway, later to prove unsuccessful, was in operation, and additional public transportation was provided by a line of coaches running on regular schedule.

Hampered from the beginning by the lack of experience of the city council and by the tremendous growth of the city, the city administration was ill equipped to meet its many problems. The criminal elements in any boom town operated in Leadville with increasing freedom from control by an inadequate police force and were finally curbed by lynchings and armed resistance by respectable citizens. The fire department, originally efficient on a volunteer basis, became unruly under interference of the council and finally resigned en masse. The streets were poor, and no progress whatever had been made in providing the city with adequate sanitation.

One factor in the inefficient administration was the casual financial dealings of the council. Not until 1880 was any attempt made to check on the city's financial condition. It was then discovered that the city was deeply in debt, and no complete records of past transactions could be found.

A similar situation faced the Leadville schools. With an increasing enrollment and grossly inadequate facilities, the early school boards spent the district into serious debt by 1880. But these excessive expenditures gave Leadville one of the state's finest school buildings.

The ending of the boom by the strike of 1880 and the Little Pittsburg failure brought depression to Leadville with demonstrated how boom-time frenzy results in financial disaster. Although

Leadville continued to be active and prosperous, it had by 1880 achieved the status of a stable community.

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**IMAGO MUNDI: SOME NEGLECTED ASPECTS OF THE EARLY AGE OF DISCOVERY**

(Publication No. 3164)

Robert A. Kress, Ph.D.  
University of Minnesota, 1951

The problem of this thesis was to discover the nature and extent of geographical knowledge in Europe during the "age of discovery," especially in the period 1450-1550. Geographical knowledge current at the beginning of this period may be characterized roughly as academic, the geographical lore of scholars concerned with cosmography, and empirical, the practical compiled by those engaged in commerce and preserved in portolani maps.

The academic knowledge was found to be based upon the accumulated geographical lore of the ancients. There was some evidence of cross-fertilization from the empirical chiefly through the accounts of travellers. The idea of the sphericity of the earth which the ancients developed was never lost, and appeared both in the academic and the popular discussions of geography, e.g., Roger Bacon and Sir John Mandeville. The belief that land existed in the western ocean had been preserved not only in academic lore but also in popular legend. Contrary to much modern belief, the existing geographical knowledge at the opening of this period offered no obstacle but rather encouragement to exploration of the western and southern oceans.

The failure to explore these seas earlier must therefore be ascribed to other factors, among which a technological lag in ship-building and navigation and the lack of adequate capital played a prominent part. The two chief exceptions to this lack of earlier explorations, those of the Vikings and of the Portuguese, help to confirm this conclusion. The first, across the northern seas to Greenland and Vinland, was accomplished by island-jumping, with ships durable enough but inadequate, whose technological deficiencies were out-weighed by the extraordinary hardihood and skill of the Viking sailors. The other was the achievement of a political organization whose expansion had reached the sea and led naturally to momentum of further advance along the coast of Africa. The original motives for that expansion were political and religious, the state supplying the necessary financial support. Business was not sufficiently organized to command risk capital sufficient for such purely speculative exploration.

The rapidity and the wide extent of the spread of the new geographical information during the "age of discovery" is sufficient evidence that the monopoly which the Portuguese and Spaniards sought to maintain was much more apparent than real. Even

before 1450 the Portuguese seem to have called upon foreign navigators, map-makers, and sailors to help them in their exploration. They made use, too, of foreign bankers for loans to finance their expeditions. Some of these bankers required the inclusion of their representatives on those expeditions. The commercial states of Italy, Venice, Florence, and Genoa had their agents keep close watch upon developments and the reports of these agents, printed in Italy, are frequently our earliest records of new discoveries. With the advent of Charles V to the thrones of Spain and the Empire, courtiers from all parts of Europe were to be found at the Spanish court and their influence was wielded to gain privileges for their own compatriots. The reliance of Charles upon German and Dutch bankers won for them substantial concessions in newly discovered regions. The importance of clandestine encroachments upon the newly discovered trading areas which increased greatly as wealthy cargoes began to pour into Portuguese and Spanish harbors is more difficult to assay accurately. All of these factors played their part in the spread of geographical lore and help to explain why the leading centers of map and atlas making shifted early from the Iberian peninsula to Switzerland, France, Germany, and the Low Countries.

Of interest also is the persistence of ancient geographical lore throughout this period. The growth of humanistic studies seems to have given added impulse to the continued use of ancient ideas, whose theories and errors were preserved in academic circles long after the business world, now more highly organized, was using the more accurate up-to-date information of professional map-makers.

Microfilm copy of complete manuscript of 425 pages, \$5.31. Enlargements 6" x 8", 10¢ per page.

**THE HISTORY OF THE COMMERCIAL RIVALRY BETWEEN PHILADELPHIA AND BALTIMORE FOR THE TRADE OF THE SUSQUEHANNA VALLEY 1780-1860**

(Publication No. 2998)

James Weston Livingood, Ph. D.  
Princeton University, 1937

Abstract not available.

Microfilm copy of complete manuscript of 301 pages, \$3.76. Enlargements 6" x 8", 10¢ per page.

**THE AMERICAN GRAIN TRADE OF THE GREAT LAKES, 1825-1873**

(Publication No. 3543)

Thomas David Odle, Ph. D.  
University of Michigan, 1952

The purpose of this study is to describe the characteristic features of the grain trade of the

Great Lakes in order to offer a partial picture of the intersectional commerce between the East and West. The importance of the grain trade during this period was that it supplied the West with purchasing power and thus made it possible for that section to become an integral part of the developing American economy.

The related economic aspects of the trade are presented in turn. The sources of the trade are treated in conjunction with a discussion of the geographic and transportation factors responsible for the early prominence of the major Great Lakes ports. This is followed by a discussion of the transportation and handling facilities for grain on the Great Lakes and the marketing and financial arrangements of the grain trade. The results of this portion of the study indicate that the intersectional trade had several points in common with the characteristics of foreign trade. The use of domestic exchange in the period prior to the Civil War was similar to the use of foreign exchange. The treatment of the development of the marketing and financial arrangements of the trade is prefaced by a discussion of the major factors responsible for the diversion of trade from the Mississippi River to the Great Lakes. Here the superiority of the commercial system of the Great Lakes is seen to have been an important factor, particularly in the early period of the development of trade.

Consideration of the commercial revolution wrought by the telegraph and railroads carries the economic study to 1873. These modern means of communication and transportation worked significant changes in the internal economy of the United States and resulted in a shift of the major grain and flour markets from the East to the West.

The final chapter presents the influence of the trade, as an economic interest, on political developments in the United States prior to the Civil War. The trade weakened the transappalachian solidarity of the West and South and strengthened the bonds between the West and East. In addition, the failure of the national administration to consider the interests of commerce on the Great Lakes persuaded the grain dealers and other commercial interests of the Great Lakes to support the Republican party in 1860.

Microfilm copy of complete manuscript of 194 pages, \$2.43. Enlargements 6" x 8", 10¢ per page.

#### THE STATUTE OF YORK

(Publication No. 3054)

Donald Tilton, Ph. D.  
Princeton University, 1941

Abstract not available.

Microfilm copy of complete manuscript of 209 pages, \$2.61. Enlargements 6" x 8", 10¢ per page.

#### HORTICULTURE

##### SPECIFIC GRAVITY OF VARIETIES AND SEEDLING FAMILIES OF POTATOES

(Publication No. 3418)

Orrin C. Turnquist, Ph. D.  
University of Minnesota, 1951

Variation in specific gravity due to location, season, and variety was studied over a five year period using 25 varieties and 24 locations. Locations on the heavy soils in the Red River Valley ranged from 1.068 to 1.089; in the sand land area from 1.058 to 1.066; and 1.060 for one location on peat. The seasonal extremes were a low of 1.070 in 1944 to a high of 1.077 in 1948. Russet Burbank had the highest value with a mean specific gravity of 1.094 while Pontiac had the lowest value with a mean specific gravity of 1.069. Lowest value obtained was 1.043 for Pontiac on sand land in 1943, and the highest value was 1.108 for Minn. 6 in the Red River Valley in 1948. A chi-square test for homogeneity of the location by season interaction for five varieties gave a P value of 0.95. Significant variances for the interaction of variety by season, variety by location, and location by season were obtained. In inheritance studies the mean specific gravity for four seasons of the self progeny of a low parent (1.075) averaged 1.072; whereas the specific gravity of the self progeny of the high parent (1.093) averaged 1.084. The cross progeny from these two parents was intermediate with an average specific gravity of 1.079. The mean of the two self progenies (1.078) gave a better estimate of specific gravity of the F<sub>1</sub> than did the average of the two clonal parents (1.084). A correlation of 0.522 was obtained between specific gravity values taken on tubers from individual seedling plants in the greenhouse and their clonal behavior two years later in the field. A comparison of the weight and flotation methods of determining specific gravity showed a correlation of 0.8498 between the two methods.

Microfilm copy of complete manuscript of 66 pages, \$1.00. Enlargements 6" x 8", 10¢ per page.

#### JOURNALISM

##### A QUALITATIVE ANALYSIS OF RADIO LISTENING IN CHAMPAIGN COUNTY, ILLINOIS

(Publication No. 3134)

Samuel Watson Dunn, Ph. D.  
University of Illinois, 1951

The objectives of this thesis were to determine what effect membership in a certain socio-economic group had on the radio listening habits of individuals and to see how well broadcasters were serving the different groups in our society.

The material used in this analysis was collected from a fixed sample of 1388 adults in Champaign County, Illinois, in November, 1949. Respondents were contacted in Champaign-Urbana, the 19 villages in the county, and the farm areas. Personal interviewers contacted families, selected on a random basis, and asked all family members over six years of age to keep a record of their radio listening during the coming week on a diary form which the interviewer provided. This form included columns for each day of the week and appropriate spaces for the respondent to record the stations to which he was listening by fifteen-minute intervals. The interviewer collected socio-economic data for each member of the family. Individual, rather than family, listening provided the basis for this analysis.

The amount and general patterns of listening were first analyzed. Significant variations in the amount and daily patterns of listening of the various groups were found. Women listened more, even on Sundays and during the evening, than men. Rural men listened significantly less than urban men but rural women listened less than other women only on Sunday.

Radio listening was greatest in the middle educational and income groups. This finding probably reflected the beaming of much program fare at the "mass audience." The smallest amount of listening took place among the upper education, income, and age groups.

The detailed analysis of listening patterns during the day indicated that peak listening hours were not always in the evening. Among many female groups the percentage of sets tuned in at certain morning hours was well above that during the peak evening hours.

The analysis of program selection among the various groups indicated that many program types had a distinct class appeal, while others appealed to all groups. Sex was of minor importance in influencing listening to any except women's programs. However, the area in which the listeners lived influenced program listening substantially. The rural audience devoted proportionately more of its listening time to daytime variety, folk music, and religious programs and less to classical, semi-classical, popular music, discussion and sports programs.

Both education and income had decidedly more influence on the program listening of urban than rural residents. Daytime serial, mystery, religious, and folk music listening decreased as the degree of education and income increased in both areas, but the decrease was much more pronounced among urban listeners.

Older listeners tended to listen more to news and religious programs and younger ones to popular music and mysteries. There was some evidence that race and occupation are important influences on program selection.

The attitudes toward program types, number of sets in the home, influence of children on listening, audience turnover, and effect of competing programs were also analyzed as influences on radio

listening. The two most important of these seemed to be the nature of program competition and the number of sets in the home. Both should be considered by the program planner.

An analysis of overlapping audiences indicated that the radio listening public consists of many audiences. Listeners who were members of certain audiences were likely to listen also to certain other types of programs. Broadcasters can best fulfill their responsibilities by providing a variety of program fare in each area.

This study showed that there was considerable truth to the charge that broadcasters were directing a disproportionate amount of their material to the mass audience and overlooking the potential audiences that more specialized program fare might attract.

Microfilm copy of complete manuscript of 206 pages, \$2.58. Enlargements 6" x 8", 10¢ per page.

## LANGUAGE

### THE GREEK AND SANSKRIT WRITTEN ACCENT (Publication No. 3049)

Donald Carl Eugene Swanson, Ph. D.  
Princeton University, 1941

Abstract not available.

Microfilm copy of complete manuscript of 56 pages, \$1.00. Enlargements 6" x 8", 10¢ per page.

## LINGUISTICS

### THE USES OF THE FUNCTION-WORD AT IN PRESENT-DAY STANDARD ENGLISH

(Publication No. 3478)  
Kuo-Ping Chou, Ph. D.  
University of Michigan, 1952

The purpose of the present investigation is to study a function word using the techniques of structural linguistics. A survey of 150 grammatical works showed that there has been no adequate treatment on the subject of the preposition, and no scientific study of any function-word has appeared in print (Chapter I).

In order to make a thorough investigation of the uses of at in present-day standard English, a body of materials, written between 1919 and 1930 and documented with the educational background and personal history of the writers, was used as primary data, and a selection of dictionaries, novels, magazines and newspapers supplemented the limited nature of the documented materials (Chapter II).

Units of construction containing at were

recorded and classified according to the sentence type in which the at-phrases occurred (Chapters III and IV).

From the actual order positions in an utterance where the at-phrases occurred, structural positions of at-phrases in various patterns were found. This was arrived at through patterning with substitutions and expansions. The direction of modification was determined from studying the immediate constituents of layers of structure.

It was found that there were two function-words which are spelled at. One, regularly pronounced [at], forms a unit modifier with a following Class 1 word (examples: teacher, desk, door), and the other, regularly pronounced [aet], sometimes with stress, follows a Class 2 word (examples: shoot, snatch, catch, grab), as a morpheme of aspect.

The first at belongs to a group of function-words traditionally called prepositions. It was found in the materials studied for this investigation that the phrases composed of this at and its following Class 1 word are sub-divided into eight groups. As there are no distinctions in form between these groups, they have to be listed. Each group has its own structural positions in larger constructions and its own direction of modification in various sentence types.

Chapter V contains tables illustrating the positions which the at-phrases of LISTS I to VI may occupy in conjunction with form classes. The at-phrases of LIST VII (Chapter VII) are distinguished by their being able to occupy several positions in an utterance. Those of LIST VIII (Chapter VIII) are different from other at-phrases by acting like single lexical items.

The direction of modification of these several groups is separately discussed in their respective chapters.

The second at belongs to a group of function-words which are attached to Class 2 words (Chapter VI). It was found that this at follows a limited number of Class 2 words to indicate that an attempt at an action is made but no indication is given as to whether the action is successful. Example: John shot at Bill, but Bill shot John. This at is therefore different from the preposition at.

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#### STRESS PATTERNS OF THE NOUN DECLENSION IN STANDARD RUSSIAN (Publication No. 3516)

Harry Hirsch Josselson, Ph.D.  
University of Michigan, 1952

The purpose of this study is to classify the Russian nouns according to the stress patterns of their declensional paradigms and to make quantitative statements concerning the distribution of these patterns in the total lexicon of standard

literary Russian as well as in two samples of printed texts. The principal contributions of this study are: (1) the classification of the stress pattern of Russian noun declension on the basis of the mobility or immobility of the stress in relationship to the stem of the noun; (2) analysis of the relationship between the several stress patterns and other characteristics of the noun, such as the number of syllables in the stem of the noun, declensional class and gender of the noun; and (3) a statement concerning the productivity of the several stress patterns.

Part I of the study establishes the need for quantitative investigations of linguistic phenomena generally and defines the principle of productivity of a linguistic pattern. Part II reviews the existing literature in the field, demonstrating on the one hand the fact that all treatments of the problem to date result only in partial statements because of lack of completeness in numerical investigation of the material, and on the other hand acknowledging the contributions made by previous investigators. Part III describes the method and materials used in the analysis and makes three statements which simplify the classification of the stress patterns, while Part IV discusses the analysis which is represented graphically in nine tables and nine lists of nouns with movable stress patterns and featured by other survivals, such as the desinence-stressed locative 2 and enclitic stress.

Five general conclusions can be drawn from the study:

1. Of the seven numerically significant distinguishable stress patterns in the lexicon, the immovable stress type is the only productive type; all other types are unproductive.
2. The more complex the stress pattern of the paradigm of the Russian noun, the smaller its percentage in the lexicon.
3. The more syllables the stem of the Russian noun contains, the greater the likelihood that the noun will have immovable stem stress.
4. In nouns having more than one syllable, the immovable stem stress tends to be located either at the end of the stem or near it.
5. As soon as additional data are available further statistical investigation needs to be done to examine the correlations between the frequencies of the several stress patterns in the lexicon and in usage, both in literary texts as well as in connected speech.

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A LEXICAL AND SEMANTIC STUDY OF OLD FRENCH JOGLEOR AND KINDRED TERMS

(Publication No. 3537)

Raleigh Morgan, Jr., Ph. D.  
University of Michigan, 1952

This is a lexical and semantic study of Old French jogleor and kindred terms which grew out of a study of the mediaeval fabliaux. Scholars leave unexplained a number of expressions which contextually refer to the jogleor or are used in phrasal combination with this term.

The material has been selected after a systematic search of Old French and Old Provençal literature, of mediaeval bilingual glossaries, and of primary historical and other non-literary sources. Critically edited texts have been used and the data have been limited primarily to French before 1400.

The mediaeval jogleor seems to be primarily a descendant of the Roman mimus. The term was used as a general designation for one who entertained either the people on the streets, at fairs, special events, or the kings and noblemen at the court, by singing, playing an instrument, reciting fabliaux or epics, dancing, tumbling, juggling, knife-throwing, magic, jesting, exhibiting trained animals, buffoonery, operating marionette shows, and the like. Because debauchery, gambling and other vices were habitually associated with wandering minstrels and actors in the minds of many, numerous pejorative connotative values were soon attached to jogleor and its synonyms.

This indicates that jogleor had many marginal meanings and supplementary values and evidence from mediaeval Latin and the other Romance languages confirm this. If the speaker wished to indicate more precisely a marginal meaning of the jogleor, he might use a 'specialty' name such as vieleor, harpeor, conteor, chanteor, estrumenteor, or sauteor, baleor, or the phrasal combinations joeor d'apertize, d'arbalaistriaus, des bastiaus. Sometimes, to avoid unfavorable connotation, euphemisms were used, such as menestrel de bouche, menestrel de haults instruments; and in the south, joglar de boca. Perhaps rimeur and westour, and even troveor and troubadour belong in this category. His social status was also accountable for terms of ridicule and disapproval such as lecheor, ribaut, pautener.

While the evidence is not conclusive, it seems likely that the term jogleor may have different connotations for different social groups, if one considers the uniformly meliorative senses in the chansons de geste, and the generally pejorative sense in works with a religious motif, and the usually burlesque connotation of the fabliaux as valid criteria.

As corollary to the general conclusions, it is suggested that joueur d'arbalestriaus is a 'specialty' term for the jogleor. Since archery was a social game as well as a war occupation, the jogleor must have added that skill to his repertoire. The term arbalaistriaus was apparently an epithet and is

analogous to French pistolet, used in referring to an individual in an unfavorable sense. It is also suggested that there exists a semantic and etymological connection between meridional bagastel ('marionette') and northern baastel ('juggler's instrument') on the one hand, and Italian bagattella ('jugglery') and Neapolitan bagattella ('puppet play') on the other. There is also a relationship between northern escanbot and Gascon escamboutà ('flail or thresh sheaves with a stick' or 'deceive'), Spanish escamotar, and modern French escamoter. Spanish camodar, a slang term meaning 'to do juggling tricks,' also invites attention in this particular problem.

Microfilm copy of complete manuscript of 172 pages, \$2.15. Enlargements 6" x 8", 10¢ per page.

LITERATURE

THE INFLUENCE OF KEATS ON THE POETS OF THE INTERREGNUM (1821-1843)

(Publication No. 2917)

Everett Edward Bostetter, Ph. D.  
Princeton University, 1938

Abstract not available.

Microfilm copy of complete manuscript of 285 pages, \$3.56. Enlargements 6" x 8", 10¢ per page.

THE POETRY OF RALPH KNEVET  
(1601-c. 1671)

(Publication No. 3459)

Amy Marie Charles, Ph. D.  
University of Pennsylvania, 1951

Although Ralph Knevet seems to have been little known, even in his own day, his poetry is of interest today because it reflects some of the styles of seventeenth-century poetry. Apparently Knevet had little contact with important literary figures of his time; it is perhaps natural, therefore, that he should have turned to an earlier period for much of his literary inspiration. In his early writing there is more of Spenser than of Jonson; in his later work more of Herbert than of Herrick. Thus his work represents a distillation of several Elizabethan poetic fashions as well as some contemporary styles.

Knevet's surname is a variant of the name of a great Norfolk family, the Knyvets, but no evidence of the exact blood relationship has been found. We know these few facts about his life: he was baptized at St. Margaret's, Hardwick, on 19 February 1601 (Oldstyle); he was admitted pensioner at Peterhouse College, Cambridge, on 3 September 1616, matriculating on 5 July 1617; his name appears in the Peterhouse Buttery Book between 7 September 1616 and 19 September 1618; he published his

ΣΤΡΑΤΙΩΤΙΚΟΝ: or, a Discourse of Militarie Discipline in 1628 with complimentary verses by a number of important Norfolk men; it is written in vigorous, effective couplets; in 1631 he published Rhodon and Iris, a quasi-dramatic "pastoral" for the Norwich Society of Florists, presented on 3 May 1631; in 1635 he completed A Supplement of the Faery Queene in Three Bookes, which remains in manuscript today; in 1637 he published Funerall Elegies, "Consecrated to the immortall memory of the Right honorable the Lady Katherine Paston," in which he styles himself "her most unworthy beneficiary"; thereafter, probably in the forties, he began A Gallery to the Temple, a manuscript containing eighty devotional lyrics, dedicated to Sir Robert Paston's wife; he became rector of St. Michael's, Lyng, shortly before 12 February 1652; his will, dated 22 January 1671, was proved on 16 July 1672. What happened from the time Knevett left Cambridge until he was installed at Lyng we can only guess; it has been suggested that he was the Pastons' chaplain or tutor.

Knevett's elegies lament in formal but highly complimentary terms the death of Lady Katherine Paston. The third, in the Spenserian stanza, is especially important because it demonstrates Knevett's handling of that form and provides a link with the Supplement of the Faery Queene, a 576-page manuscript long ascribed to Robert Jegon because a commendatory verse by him is included. Examination of the handling of the Spenserian stanza, handwriting, and spelling, however, affirms that Knevett wrote this work, from which all traces of authorship have been removed, probably for political reasons. Both the dedications and the allegory reflect Knevett's Royalist sympathies.

The devotional lyrics in A Gallery to the Temple, varied in length and form, are in the manner of George Herbert and express Knevett's personal faith and his desire for greater zeal in religion.

Knevett's poetry reflects an interest in the classics, public weal, science, and his two chief poetical masters, Spenser and Herbert. For Knevett poetry has a high ethical function, the duty of instructing and elevating. His own poems, though varied in content, are generally serious in tone. He uses the conceit as decoration, not as an integral part of the poem, hence is not a true metaphysical poet. Certainly Ralph Knevett is not a major seventeenth-century poet, but he is an interesting minor one whose work epitomizes several aspects of Caroline — and earlier — poetry.

Microfilm copy of complete manuscript of 199 pages, \$2.49. Enlargements 6" x 8", 10¢ per page.

**A STUDY OF THE MEANING AND SYMBOLISM  
OF THE ARTHURIAN POETRY  
OF CHARLES WILLIAMS**

(Publication No. 3485)

Reverend Cornelius Patrick Crowley, C.S.B., Ph.D.  
University of Michigan, 1952

This study is an attempt to elucidate Charles Williams' poetic myth of the Grail, particularly as it is set forth in his volumes Taliessin Through Logres and The Region of the Summer Stars. The dissertation is divided into two parts. The first, consisting of four chapters, sets forth Williams' concept of the meaning inherent in the romantic stories of Arthur and the Grail, and shows how he undertook to create a poetic myth from elements in the traditional material which he thought had been neglected by earlier English poets. After a brief summary of uses made of the Grail story by English writers who in general have regarded the theme as susceptible only of a vague ethical treatment, there follows a study of Williams' thought and idiom. The latter is shown to be a personal expression of a sacramental attitude toward life based on the belief that the Incarnation is the central fact of history with an ultimate meaning for all men of every age. This theology is shown to be intimately associated with Williams' plan for the reworking of the Grail material. From evidence found in his other writings, it appears that he sees the Arthurian tradition as a growth towards a mythic maturity, a full insight into which was never attained nor understood by English poets. His concept of myth as a symbolic narrative whose Christian metaphysic makes it spiritually significant is seen to link him with the moderns in poetic method while keeping him aloof philosophically. His intention is to create a new myth with the Grail, as its central symbol, integrating the action and supplying an adequate sanction for its spiritual values. Williams accomplishes this purpose by emphasizing the Grail as a symbol of the religious identification of the soul with Christ. The section concludes with an illustration of the method to be used in reading Williams' poems. This includes a summary of the Arthurian story as it was built up by Williams, an analysis of his themes, an examination of his language, literary allusions, and symbolic interpretation of sources. Use is made of many clues to meaning and method found in the writings of Williams and his friend Mr. C. S. Lewis, and there is an attempt at a wider critical environment in the light of current theories of poetry.

In the second part of the study four poems selected to represent Williams' mature thought and style are analyzed in order to provide a commentary which will assist a reader to deal with Williams' difficult text, to bring out their special literary qualities, and to show a relation to the themes already discussed.

The study reveals that Williams has given the Arthurian story a cosmic and Apocalyptic relevance by relating it to the Grail and the Parousia. He

imagines that the kingdom is the appointed site of the Second Coming and the Apocalyptic City of God, but when it proves unworthy, its citizens are given a chance to achieve the Grail and the City of God individually. Their experiences are adventures of the soul: love, poetry, politics, asceticism, and marriage. The general action of the myth as a drama of Christian love extends beyond time and space and becomes symbolic of the spiritual Odyssey of man. The dissertation reveals that Williams' myth is a rich and fresh poetic creation possessing a triple significance: (1) literal: in the tale of Galahad and the members of the kingdom of Arthur; (2) mystical: as it concerns their success or failure in the achievement of Mystical Union; (3) mythic: as symbolic of the theological history of man related to the Incarnation and the City of God.

Microfilm copy of complete manuscript of 404 pages, \$5.05. Enlargements 6" x 8", 10¢ per page.

#### A HISTORY OF ITALIAN COMEDIANS IN SPAIN A CHAPTER OF THE SPANISH RENAISSANCE

(Publication No. 3492)

John Vincent Falconieri, Ph.D.  
University of Michigan, 1952

The purpose of this study is (a) to synthesize all known facts pertaining to the Italian theatrical companies that traveled and performed throughout Spain during the sixteenth century, (b) to prove that these companies and their actors contributed to the material growth of the Spanish theatre, and (c) to show that the visit of these Italian companies was a natural consequence of centuries of political, economic, and cultural contacts between Spain and Italy.

The first chapter traces the cultural relations between these countries in the Middle Ages and the Renaissance. Beginning with the barest contact around 1100, the interrelationships increased, as the centuries passed, at an ever accelerated pace culminating in extensive and intensive relationships during the sixteenth century.

The second chapter deals with the state of the theatre in Spain and Italy. In the latter country the so-called erudite theatre developed through direct imitation of classical writers and through direct application of classical precepts. The reaction to this engendered a popular theatre which may be divided into two genres: a written farce or comedy, and the masked comedy, known as the Commedia dell'Arte. In Spain the theatre continued its development from the medieval religious plays, slowly becoming more secular in nature. Lope de Rueda appeared on the scene following the tradition of the Italian comedies and their actors. Poetic substance was eventually given this theatre by Lope de Vega. The academicians, who principally performed the erudite plays in Italy, made several appearances in Spain on special invitation. But they performed in the palaces and never for the general

public. However, the Commedia dell'Arte comedians performed in many of the larger cities in Spain, in the palaces, in the city squares, in the public theatres, and even during religious festivals. The foremost of the Italian companies in Spain was that of Alberto Naseli, alias Zan Ganassa, who won great renown in that country. The third chapter concerns Ganassa's company and the effect it made in Spain.

The next chapter deals with various other companies that appeared on the Spanish stage, such as the company of Joan Jacome which performed principally in Valencia, that of Massimiliano Milanino in Valladolid and Madrid, that of Drusiano Martinelli in Madrid, etc. The visits of the Italian companies came to an abrupt end around 1590 when the Spanish public turned its interest towards the nascent national theatre of Lope de Vega and his contemporaries.

The final chapter discusses the theatre as a discipline in itself, comprised of many art forms which cannot be considered individually, but rather as a composite. Most studies dealing with the Commedia dell'Arte revolve around its literary content, a content of which it is practically devoid. The chief contribution of the Commedia dell'Arte in Spain as elsewhere was the actors' sense of theatricality, through which they were able to transform the science of acting into a cultured art. In Spain, these comedians were instrumental in the construction of theatres, in the introduction of women upon the stage, in organizing theatrical companies along modern lines, and in making the theatre an everyday function of civil life.

Microfilm copy of complete manuscript of 143 pages, \$1.79. Enlargements 6" x 8", 10¢ per page.

#### EDWARD YOUNG'S SATIRES MATERIALS FOR AN EDITION OF LOVE OF FAME, THE UNIVERSAL PASSION

(Publication No. 2952)

Charles Edward Frank, Ph.D.  
Princeton University, 1939

Abstract not available.

Microfilm copy of complete manuscript of 200 pages, \$2.50. Enlargements 6" x 8", 10¢ per page.

#### A COMPARATIVE STUDY OF THE KĀWŪS, NIMROD AND ALEXANDER ASCENSIONS IN ORIENTAL LITERATURE AND ART

(Publication No. 2955)

Harold Walter Glidden, Ph.D.  
Princeton University, 1937

Abstract not available.

Microfilm copy of complete manuscript of 110 pages, \$1.38. Enlargements 6" x 8", 10¢ per page.

**THE CRAFT OF GENIUS:  
A STUDY OF EMERSON'S POETIC  
DEVELOPMENT 1823-1846**  
(Publication No. 2968)

Thomas Gonder Henney, Ph. D.  
Princeton University, 1946

Abstract not available.

Microfilm copy of complete manuscript of 314 pages, \$3.93. Enlargements 6" x 8", 10¢ per page.

**A TEXTUAL COMPARISON OF A SECTION  
OF THE ARABIC KALILAH WA-DINNAH  
AND THE CORRESPONDING SECTION  
OF THE OLD SPANISH CALILA E DIGNA**

(Publication No. 2981)

Thomas Ballantine Irving, Ph.D.  
Princeton University, 1940

Abstract not available.

Microfilm copy of complete manuscript of 90 pages, \$1.13. Enlargements 6" x 8", 10¢ per page.

**THE LITERARY VIEWS  
OF OLIVER GOLDSMITH**

(Publication No. 3515)

Coragreene Johnstone, Ph. D.  
University of Michigan, 1952

This study describes the literary views of Oliver Goldsmith with the aim of systematizing his literary opinions. As a well-known professional writer, he contributed essays on literature which were widely read. He associated with Johnson, Reynolds, and Burke, the most prominent literary men in England; and he was one of the original members of the Club. His opinions of literature, therefore, interest a student of the last half of the eighteenth century.

Since he was not a systematic critic, some order has been imposed upon his concepts. As a result of the study, three questions have been answered: (1) What is Goldsmith's concept of the characteristics of the author? (2) What is his concept of the purpose and technique of the literary work? (3) What does he think the effect of the literary work should be upon the audience? Since Goldsmith is writing at the time when the "author by profession" was just coming into existence, his opinions of the author and the critic of his time are

revealing and penetrating. They have, then, been included with a statement of his critical method as he exhibits it in An Enquiry, the reviews, and the critical essays he contributed to such magazines as the Bee, Public Ledger, British Magazine, and Westminster Magazine.

With reference to the author, Goldsmith held an idealistic view of the artist as seer and teacher. Although Goldsmith is not a theoretical critic, nevertheless, he expressed his views on such theoretical topics as the author as "genius"; and he wrote of his invention, imagination, judgment, and taste. On the question of the qualities of the author, he maintained the neo-classical belief in the primacy of the judgment, and he held that taste is the arbiter when the imagination and reason come into conflict. Although he believed in the Aristotelian doctrine of imitation, he thought that the author should copy nature directly and produce original works instead of imitating the ancients. He had little reverence for such ancients as Homer, Pindar, and Horace; and he held up for his ideal the writers of the reign of Queen Anne, notably Pope.

As for the literary work, he believed that it should represent ideal nature. Its function is to present a blend of the delightful and useful. It should elicit from the audience the emotional effects of the beautiful, the sublime, or the novel. On the matter of genres, Goldsmith disliked the modern epics, elegies, pastorals, and Pindaric odes that were being written. He preferred narrative, descriptive, and didactic poetry; and he showed no appreciation for the lyric. Blank verse he considered a kind of pedantry; he praised the heroic couplet. Although he wrote a novel, he did not like the novels of his day, believing that they gave young people the wrong ideas about friendship and love. He disliked sentimental comedy, which he considered to be a mixture of the genres and a flattery of "every man in his favourite foible"; and he wrote two laughing comedies to prove that plays illustrating humour and character could be successful.

Finally, Goldsmith thought that the "author by profession" was to be preferred to the dilettante. He decried the social position of the professional writer, who deserved more respect from the learned. Although he stated the legitimate function of criticism and the critic, he disliked the actual critical practices in England.

Goldsmith was not a systematic critic, so that there exist some inconsistencies in his critical opinions. He was both a defender and opponent of neo-classical traditionalism. As a critic he pointed out the beauties instead of the faults, used the historical method, and was an aesthetic relativist; he wrote general rather than specific criticism.

Microfilm copy of complete manuscript of 284 pages, \$3.55. Enlargements 6" x 8", 10¢ per page.

SOME CULTURAL ASPECTS  
OF THE QUINQUENARIOS OF PEDRO  
GUTIÉRREZ DE SANTA CLARA

(Publication No. 3520)

Robert Baker Knox, Ph. D.  
University of Michigan, 1952

The purpose of this study is to examine the cultural aspects of the Historia de las guerras civiles del Perú, called Quinquenarios, of the sixteenth-century Mexican historian, Pedro Gutiérrez de Santa Clara.

Although it belongs to the province of history, this work has much to interest the literary historian and the student of Spanish-American culture. Few books better exemplify the multiple affiliations between literature and history in that period and environment. The insights afforded into the background and cultural attainments of a sixteenth-century Spanish American of low social standing and little formal education are likewise rewarding. This work is unusually instructive in that respect because of the variety of its literary and cultural contents. Moreover, it abounds in the sort of picturesque detail that helps to make history live for the general reader.

Despite its significance for the literary and cultural record of early Spanish America, its readability, and its value as a historical source, very little research has been done on the Quinquenarios. Indeed, the work appears to be relatively unknown, being rarely mentioned even by historians of colonial Spanish America. Hence, the purpose and justification of a study such as the present one.

The principal contributions of this study are the following: (1) A detailed consideration of the literary features of the Quinquenarios, which consist of such items as assorted fragments of poetry, proverbs, tales and anecdotes, portraits, speeches, and matters of style. (2) An evaluation of attitudes and interests of Gutiérrez de Santa Clara and their relation to the intellectual currents of the times — notably the Renaissance. The presence of Renaissance characteristics in Gutiérrez de Santa Clara assumes special significance on account of his comparative lack of education and on account of the oft-encountered assumption that Spain, and particularly her colonies, participated little if any in the Renaissance. (3) An appraisal of Gutiérrez de Santa Clara's background as revealed in such things as authorities cited and references to ancient history. (4) Discovery of decisive evidence concerning the identity of Pedro Gutiérrez de Santa Clara's father. (5) A more detailed study of Gutiérrez de Santa Clara's sources for the Quinquenarios than has hitherto been made.

Microfilm copy of complete manuscript of 168 pages, \$2.10. Enlargements 6" x 8", 10¢ per page.

SIR THOMAS BROWNE AND THE BIBLE

(Publication No. 2999)

Josiah Marshall Linton, Jr., Ph. D.  
Princeton University, 1939

Abstract not available.

Microfilm copy of complete manuscript of 197 pages, \$2.46. Enlargements 6" x 8", 10¢ per page.

CHATEAUBRIAND AS A HISTORIAN  
AND CRITIC OF FRENCH LITERATURE

(Publication No. 3002)

Carlos Lynes, Jr., Ph. D.  
Princeton University, 1939

Abstract not available.

Microfilm copy of complete manuscript of 557 pages, \$6.96. Enlargements 6" x 8", 10¢ per page.

THE WAVERLEY NOVELS IN THEIR  
RELATIONS TO GOTHIC FICTION

(Publication No. 3010)

Robert Donald Mayo, Ph. D.  
Princeton University, 1938

Abstract not available.

Microfilm copy of complete manuscript of 487 pages, \$6.09. Enlargements 6" x 8", 10¢ per page.

THE PLACE OF AE IN IRISH CULTURE

(Publication No. 3450)

Francis John Merchant, Ph. D.  
New York University, 1951

Although AE was acclaimed as "one of the noblest figures in the Irish intellectual movement,"<sup>1</sup> the nature of his rich and many-dimensioned thought-world has received comparatively little attention. In 1950, fifteen years after his death, most of AE's books were out of print; moreover, the publishing company that refused to re-issue them had brought out a volume by Sean O'Casey that contained a slanderous attack on the character and achievements of AE. Then, too, practically nothing had been written about AE's economic and political ideals or the canons of criticism he developed in literature and art.

In gathering material, the investigator travelled to Ireland and England, and spoke to persons who had known AE. Not only were his books carefully studied, but letters written by him to friends were unearthed, and a correspondence with prominent acquaintances continued over a period of many months.

1. Legouis, Emile and Cazamian, Louis. A History of English Literature. p. 1326.

The full scope of AE's major interests received attention. The problem of expounding his total contribution was broken down into seven sub-problems: (1) mysticism and religion (2) economics (3) politics (4) literature (5) the Irish drama (6) art; a final chapter indicating the nature of his relations with various persons of prominence, such as W. B. Yeats, George Moore and James Stephens, was also included.

A brief summary of findings in connection with these sub-divisions will serve to emphasize the results of research.

#### 1 Mystical Philosophy:

In the writings of AE one finds (a) a cosmogony (b) a psychology and (c) a system of ethics. His cosmogony centers about a belief that man made a Promethean-like sacrifice in the far distant past to reclaim the earth, an outpost of darkness, for the Light. The psychology he advocated stresses the superconscious, that is, the world which lies beyond the horizons of the senses. Meditation is the method he recommended in order to enlarge the dimensions of awareness. Basic concepts in his ethics were (a) gentleness (b) cast no one out of your heart (c) kindness and compassion (d) detachment and (e) the law of service.

#### 2 Economic Ideals:

AE played a significant part in the Irish Cooperative Movement. He was profoundly interested in building a new social order. He believed that the average man must have a greater stake in society, and that cooperation must be the keynote of the economic and social system. A rural civilization should be created; it must be founded on the principle that economic and moral law are one and the same. Sacrifice, the fundamental law of militarism, must find expression in civil life. He also insisted that women be permitted to assume a more important role in the life of the nation. Cooperation, he held, could provide a significant answer to the ideology of Communism.

#### 3 Political Activities:

AE was an active figure in the National Convention of 1917 which unsuccessfully sought to unite Northern and Southern Ireland.

AE propounded what might be called mystical nationalism. A national being presides over the destiny of each nation, and it is the task of citizens to discover and carry out the will of that entity.

AE deplored the tendency to exalt passion above reason in politics. The development of the understanding should enable men to reconcile contraries. Political strife in Ireland often arose, he held, from the pursuit of differing ideals. Freedom and solidarity, for instance, represented two ideals whose opposition brought about much conflict. The Unionist beheld the vision of solidarity, the revolutionary, that of freedom.

It was AE's belief that a nation is molded in the image it contemplates; and this formed the basis for his "law of antagonism."

As he grew older AE upheld the ideal of world citizenship, and demanded that all nations practice the diplomacy of friendship.

#### 4 Literary Achievements:

The fountains of poetic song, AE maintained, spring from remote areas of consciousness. In his poetry one finds an exaltation of man to divine proportions, a conception of nature as the outer garment of a compassionate being whom he calls the "Mother," and love poetry which raises the relations of the sexes to cosmic proportions.

Plato's ladder of beauty, ascending from the less to the more refined aspects of the beautiful, served AE as a canon of criticism. Artistic creation must be spiritual, he held, but not necessarily in conformity with narrow morality. Great literature must bring out the greatness in man.

#### 5 Dramatic Interests:

AE was instrumental in founding the Irish National Theatre, and discovering William and Frank Fay, who brought native actors to the Irish stage.

At various times AE protested against a realism that emphasized the shoddy surface of life and refused to plumb spiritual depths.

Deirdre is the only play AE wrote. Synge and Yeats also treated this theme. AE's interpretation differs from theirs in large measure because of his mystical and visionary sense.

#### 6 Art Criticism:

The cult of the ugly found no champion in AE. He commended modern art for breaking with tradition, but not for exalting ugliness. On the other hand, he believed that the pursuit of beauty as an end in itself could have undesirable results. It is the beauty which Plotinus considered to be an attribute of God that AE stressed.

Spiritual values should find expression in art. In criticizing a painting, AE first sought to comprehend the vision of the artist who executed it. When the painter forsakes his own vision in order to shock or to please his public, art is commercialized and debased.

#### 7 Friends and Enemies:

AE was one of the outstanding figures of the Irish Literary Renaissance. He was closely related to the other leading authors and playwrights. The nature of his relations with such persons as George Moore, W. B. Yeats, James Stephens, Sean O'Casey, Lord Dunsany, Lady Gregory and others is the central theme of this chapter.

Microfilm copy of complete manuscript of 577 pages, \$7.22. Enlargements 6" x 8", 10¢ per page.

**THE INWARD EYE: A REVALUATION  
OF COLERIDGE'S PSYCHOLOGICAL CRITICISM**

(Publication No. 3533)

Kenneth Millar, Ph. D.  
University of Michigan, 1952

The purpose of this study is to establish the meaning of Coleridge's literary criticism, by discovering its basic principles and method, and the historical purposes which it served. Since Coleridge based his poetic theory on psychological principles which he developed through observation and introspection, and through extensive reading in classical psychology beginning with Aristotle, a large part of the present study is devoted to his psychology, and to its background in European and English philosophy and psychology. Its immediate historical context was the dualistic philosophy of the seventeenth century and the mechanistic psychology which issued from it in the eighteenth century. Coleridge's own dynamic psychology, and the poetic which he developed *pari passu* with it, is explained as a conscious reaction against the 'passive mind' of associationism, and the divided mind of Cartesianism.

As the Introduction attempts to show, the dualistic philosophy and the mechanical psychology which dominated English thought throughout the eighteenth century were regarded by the early Romantic poets as threats to the unity and creativity of the human mind, on which the writing of poetry seemed to depend. Coleridge assumed the task of devising a dynamic psychology which should both explain and justify free poetic creation in an era of scientism. Chapter II describes his use of Aristotle for this purpose, and his completion of the classic theory of imitation with a conception of creative imagination, exempt from the necessity of telling scientific truth. This conception of creative mind arose, as Chapters III and IV demonstrate, from the dynamic theory of cognition and aesthetic expression which constituted Coleridge's answer to the eighteenth-century machine psychologies, exemplified by Hartley, and from the principle of psychic and natural unity which he opposed to the Cartesian and Hobbesian dualistic philosophies described in Chapter V. In clearing the ground for a dynamic poetic, as Chapter VI shows, Coleridge made use of Berkeley's criticism of Locke; and was assisted in the formulation of his own imaginative poetic by the psychological school of eighteenth-century critics which stemmed from Addison.

The concluding chapters, VII and VIII, describe in detail the theories of symbolic expression and poetic method which Coleridge based on his psychology, and his closely related theories of organic unity, poetic belief, and poetic value. In interpreting these theories in the light of a psychology which provided Coleridge with his critical principles, the present study aims to present a more coherent and exact exposition of their meaning than has previously been available, and to show that they constitute the central statement of the English Romantic movement.

Microfilm copy of complete manuscript of 458 pages, \$5.73. Enlargements 6" x 8", 10¢ per page.

**THE RHETORIC OF SIDNEY'S ARCADIA**

(Publication No. 3012)

Peter MacNaughton Miller, Jr., Ph. D.  
Princeton University, 1939

Abstract not available.

Microfilm copy of complete manuscript of 262 pages, \$3.28. Enlargements 6" x 8", 10¢ per page.

**CONCEPTS AND SYMBOLS IN THE POETRY  
OF R. M. RILKE**  
**A STUDY OF THEIR DEVELOPMENT**

(Publication No. 3195)

Richard Bernard O'Connell, Ph. D.  
University of Minnesota, 1951

It is the purpose of this study to trace in Rilke's poetry the appearance and evolution of the principal concepts and the symbols through which they are represented.

Basic to the development of the artist, as Rilke sees him, is longing. "Absolute" longing is essentially identical with the compulsion to create. "Natural" longing, appearing most characteristically as "Maedchensehnsucht," exerts a considerable attraction upon the artist but is foreign to him. "Absolute" longing can lead the artist to an ideal, timeless sphere. "Natural" longing is spontaneous, aimless, and evanescent. Non-esthetic but otherwise very close to "absolute" longing is a quality attained by the woman who carries "Maedchensehnsucht" to a higher level or learns to give love an infinite goal. "Natural" longing comes to be comprehended in the concept of "feeling." "Absolute" longing becomes closely associated with "things" ("Dinge") and with God, the basic force pervading the universe. For-saking the infinite, its initial goal, the "absolute" longing of the poet turns to "Dinge," which teach it to respond fully but impartially to experience.

The poet's attitude toward life and death is determined by his belief in the necessity of art. His search for the essential nature of human existence leads him beyond conventional attitudes and judgments about it, and his apprenticeship to "Dinge" teaches him that death's face is usually hidden by a mask comprised of man's misconceptions. To live fully, as the true artist does, is to accept experience impartially. To die is to achieve life's culmination — complete receptivity.

Underlying the concepts of "pure" and "real" existence is a fundamental dichotomy in Rilke's thinking. "Pure" existence is enjoyed by "Dinge," which have no self-awareness and, consequently, no consciousness of their own impermanence. The poet, yearning for "pure" existence, is barred from it by the compulsion to add reflection to experience. In his desire to justify rationally his innate faith in the necessity of art he finally arrives at the conclusion that "pure" existence, being subject to time, is imperfect and therefore inferior to the "real" (immutable) existence which the artist — through his

reflective capacity — can give to the temporal world. At the same time, Rilke's late poems are characterized by a glorification of feeling (in which experience and response are identical). The poet's half-suppressed love for music is a part of his natural preference for non-reflection.

Rilke's principal symbols are initially descriptive of the conditions under which the creative impulse can thrive, then indicative of the poet's theoretical preoccupation with the nature of his subject matter, and, finally, concerned with an apotheosis of the artist.

The symbolic qualities of "Schweigen," "Einsamkeit," and "Seele" sum up the "absolute" longing which Rilke sees as the impulse to art. The principal symbols of time-bound "natural" longing are the "Maedchen," the "Kind," and the process of "Bluehen."

"Dinge," which come to occupy a large part of the poet's attention, symbolize God, the basic force of the universe.

In the organic processes of "Bluehen," "Reifen," and "Fruchttragen" Rilke's concepts of life, death, and the artist are all comprehended. "Reifen" and "Fallen," essentially identical, point to the concept of "der grosse Tod."

On a plane of symbolism which approaches the mythological appears the artist-god Orpheus. His dual nature embraces everything which has "pure" existence, and, simultaneously, lends "real" existence through "praising." At the very summit of Rilke's symbol-pyramid — on an even higher level than that occupied by Orpheus — is the angel. Dwelling in a sphere where time is non-existent, he is the ideal artist, in whom feeling and reflection are identical.

Microfilm copy of complete manuscript of 166 pages, \$2.08. Enlargements 6" x 8", 10¢ per page.

#### SAMUEL CLEMENS'S TECHNIQUE AS A HUMORIST, 1857-1872

(Publication No. 3091)

Paul Steward Schmidt, Ph. D.  
University of Minnesota, 1951

Samuel Clemens's humor — what we think of as his richest vein — can best be understood as a burlesque of the genteel tradition. The popular traditions of American vernacular humor gave him the rudiments of his method and the form of the journalistic sketch which he used throughout his apprenticeship. But almost from the beginning he was able to direct these inherited resources toward undertakings of considerable moment: a searching criticism of genteel orthodoxy and an affirmation of the values of the "Western" community with which he identified himself. His work beginning with the early newspaper sketches (1857) through *Roughing It* (1872), uneven as it is, establishes patterns which are important for understanding what is going on in *Huckleberry Finn*, patterns of form, style, and content. The form is mainly burlesque.

The style is vernacular. The content is a Western counterattack upon the derogatory genteel stereotype of the Westerner, which unfolds into a full-scale criticism of the genteel tradition itself.

Clemens's answer to this stereotype rests on a critique of genteel assumptions which carries a great deal more weight than it has been given credit for. It is a criticism which perceives more than mere conservative conformity in the genteel tradition: it sees beyond this to a competitive striving which shatters any attempt at community, a drive toward self-aggrandizement in which the prime value, individualism is nourished by the illusion of what this study calls primitivism. Clemens rejects individualism as he finds it operating in the beaux arts, in "pure" science, in republican politics, and in the Protestant religion; and in doing so he takes issue with the romance traditions of love, an aesthetics based on contemplation and "taste," humanitarianism, Enlightenment politics, and Reformation religion. This rejection might be dismissed as cynicism were it not that he affirms in his humor positive values which he perceives in the Western vernacular community. He senses here an appreciation of sensuous detail which is distinguished by a working relationship to objects rather than a passive relationship. The major and sustaining value of this community is brotherhood: by virtue of it such vernacular characters as Mr. Ballou, Dick Baker, and the narrator of "The Celebrated Jumping Frog" have a zest and capacity for experience which win Clemens's unqualified admiration.

When Clemens left the West as a traveling correspondent in the Sandwich Islands (1866) his work began to show the effects of a shift in his conception of his audience: he no longer addressed himself to a Western mining audience but to a general reading public in which, apparently, he felt that genteel tastes must be taken into account. Alongside burlesques of genteel ideas and attitudes now appear, incongruously, serious exploitation of the very same ideas and attitudes. He is satirical at the expense of the Protestant Pilgrims in *The Innocents Abroad*, for example, while elsewhere in the same book he is identified with the Protestant and Enlightenment case against Catholicism — *ecrasez l'infame*; he makes trenchant and significant satire on the stereotyped "pioneer" and "Westerner" for *Roughing It* at the same time that he takes these stereotypes seriously. His revisions of his newspaper correspondence for these two books provide further confirmation that he underestimated, on a conscious level, his vernacular materials and that he was willing to go to great lengths to adapt his work to what he thought was his new audience. Despite magnificent passages of satire the overall design in these first two books tends to be vitiated by this bifurcation.

Microfilm copy of complete manuscript of 390 pages, \$4.88. Enlargements 6" x 8", 10¢ per page.

**WAR AND LECHERY: FOUR THEMES  
IN THE NON-SHAKESPEAREAN  
ELIZABETHAN THEATER, 1587-1603**  
(Publication No. 3207)

William Arthur Sylvester, Ph. D.  
University of Minnesota, 1951

The Elizabethans viewed the cosmos as an organic whole. As a result, they say a very close association between private and public affairs. It is not surprising to find such an association in the non-Shakespearean Elizabethan theater. Public affairs have, however, such a decisive role in these plays that private affections are in effect belittled. Perhaps inadvertently, the dramatists have stressed the importance of the State in such a way that the State actually appears in the plays as an end in itself and as so important an end that the divine sanction (under which the State presumably operates) is disregarded.

In order to show how private affections are thus belittled, I have found it convenient to classify the plays under four heads.

In plays on the theme of what I call "Rational Love," the characters control their emotions by the strength of their minds. They are so virtuous that they deny their emotions rigorously. If they have to struggle with their emotions, we see them not so much supporting the State as failing to upset it.

Other plays illustrate the theme of "Fortunate Marriage." Here lovers are brought together by some supernatural agency. The lovers marry and thus enjoy the approval of society, but the happy conclusion is presented as a comic and fanciful whim of irresponsible forces.

Still other exhibit "Lechery as a Disease." Here an illicit relationship is represented as the result of some overwhelming force (an Ate, or Fate or perhaps lust, but lust treated as irresistible). This force can corrupt a noble prince, and by corrupting him, corrupt an entire kingdom.

"Lechery a Freely Chosen Evil" is the name of my fourth and final category. In plays on this theme, an illicit relationship is entered into knowingly and wilfully by fully responsible characters, whose free choice of evil contaminates both their private and their public lives.

The four groups of plays have thus an important characteristic in common: in all of them the State is the highest good and virtue is a willingness to serve the State. Such a willingness is so consistently upheld by the plays as an ideal that all private affections in persons of rank or of high office appear as unfortunate deviations from public duty. If the love affairs of the great prosper, they lead either to a conclusion more illustrative of luck and the holiday spirit than of virtue, or - more frequently - to calamity.

I find that Shakespeare is the only dramatist writing before 1603 to break with the rigid formula I have outlined. He is the first to permit a wide scope to the private affections of his characters. Love, in Shakespeare's plays, while not raised to the level of a categorical imperative, is often compatible with, and can even help to sustain, the burden of public duties.

Microfilm copy of complete manuscript of 189 pages, \$2.36. Enlargements 6" x 8", 10¢ per page.

**THE ORIGIN AND DEVELOPMENT  
OF THE SENTIMENTAL JOURNEY AS A WORK  
OF TRAVEL LITERATURE AND OF SENSIBILITY**

(Publication No. 3059)

Alan H. Vrooman, Ph. D.  
Princeton University, 1940

Abstract not available.

Microfilm copy of complete manuscript of 366 pages, \$4.58. Enlargements 6" x 8", 10¢ per page.

**BYRON AND THE MAGAZINES, 1806-1824**

(Publication No. 3061)

Herman Matthew Ward, Ph. D.  
Princeton University, 1940

Abstract not available.

Microfilm copy of complete manuscript of 280 pages, \$3.50. Enlargements 6" x 8", 10¢ per page.

**SIR THOMAS BROWNE'S REVISIONS  
IN PSEUDODOXIA EPIDEMICA: A STUDY  
IN THE DEVELOPMENT OF HIS MIND**

(Publication No. 3063)

Tipton Marshall Westfall, Ph. D.  
Princeton University, 1939

Abstract not available.

Microfilm copy of complete manuscript of 285 pages, \$3.56. Enlargements 6" x 8", 10¢ per page.

**MAURICE THOMPSON:  
A BIOGRAPHICAL AND CRITICAL STUDY**

(Publication No. 3200)

Otis B. Wheeler, Ph. D.  
University of Minnesota, 1951

During the last two decades of the nineteenth century, Maurice Thompson (1844-1901) enjoyed no little fame as a slashing critic of realism, as a poet, and as a writer of nature essays and fiction. With access to the principal Eastern magazines, as well as to the newspapers of his own Midwest (he was a resident of Crawfordsville, Indiana), he made a name for himself that caused his death in 1901 to be mourned in many quarters as a major loss to American letters.

His first fame came as a writer of nature essays. In The Witchery of Archery (1878) and in numerous subsequent magazine essays, he gave his public a combination of crotchety but basically genteel dicta about literature, and vivid, appealing, often humorous accounts of his jaunts in the wilds of Florida, the Southern mountains, and the Indiana countryside. In this contact with nature, beginning with his boyhood in north Georgia, he also found, he believed, one element of his critical creed, namely that urban and industrial culture was not a fit subject for art because it was too far removed from nature.

As a poet, Thompson showed but small originality (see Poems, 1892). Although some of his critical writings reflect an equivocal admiration for certain newer modes in verse, e.g., the works of Emerson and Emily Dickinson, his own poems are mostly undistinguished. He writes simple lyrics of domestic sentiment in the manner of Longfellow; he writes jingoistic patriotic verse, especially toward the end of the century, when American imperialism was waxing; he does translations from the Greek pastoral poets, chiefly Theocritus. The only work that might possibly be called notable is his nature poetry: here simple and direct lyrics are distinguished by freshness of diction, image, and rime, though metrical forms are completely traditional.

Like his poetry, his fiction is imitative. He works the gothic strain very much in the manner of contemporary writers in the New York Weekly and Ledger; his handling of the local color genre is competent and promising, although he plainly follows the lead of Longstreet, R. M. Johnston, G. W. Harris, and Eggleston; he does light romances of contemporary life — usually love stories in the sentimental tradition set against picturesque Southern backgrounds. Finally, he is a writer of historical romance. At the end of the century, after the vogue had been established by Mary Catherwood, Weir

Mitchell, Mary Johnston and others, Thompson's Alice of Old Vincennes became a best seller immediately upon publication and gave him perhaps his widest fame.

As a critic (The Ethics of Literary Art, 1893) Thompson had as his principal sounding board the New York Independent, a conservative and widely-circulated non-sectarian religious weekly, of which he was a literary editor from 1889 until his death. His vehement opposition to realism was as much social as literary criticism, since he believed that realism was both an outgrowth and a cause of the materialistic agnostic tendency in religion and daily life that was undermining American society. Because realism was founded, he believed, on the scientific method, denying genius and inspiration, it was an outgrowth of materialism; and since art molds society, because we grow like what we contemplate, realism further aggravated the situation. Thompson's protest as a whole is probably best described as moral-esthetic-patriotic, and is oriented around a mood of Victorian humanitarianism, a non-sectarian faith in the orderly progress of the world toward a social order in which personal freedom, the rights of property, and the greatest good for the greatest number, in terms of both spiritual and material welfare, shall all be harmonized.

Microfilm copy of complete manuscript of 270 pages, \$3.38. Enlargements 6" x 8", 10¢ per page.

**ENGLISH PROSE STYLE IN TRANSLATIONS  
FROM THE CLASSICS, 1489-1580**

(Publication No. 3072)

James Lemuel Wortham, Jr., Ph. D.  
Princeton University, 1939

Abstract not available.

Microfilm copy of complete manuscript of 228 pages, \$2.85. Enlargements 6" x 8", 10¢ per page.

**THE CRITICAL WORKS OF THOMAS RYMER  
WITH EDGAR; AN HEROIC TRAGEDY**

(Publication No. 3075)

Curt Arno Zimansky, Ph. D.  
Princeton University, 1937

Abstract not available.

Microfilm copy of complete manuscript of 605 pages, \$7.56. Enlargements 6" x 8", 10¢ per page.

## MATHEMATICS

## MODIFIED STURM-LIOUVILLE PROBLEMS AND ASSOCIATED INTEGRAL TRANSFORMS

(Publication No. 3467)

Walter Ferdinand Bauer, Ph.D.  
University of Michigan, 1952

This dissertation deals with the following eigenvalue problem:

$$\begin{aligned}y''(x) + (\lambda + p(x))y(x) &= 0 \\ \alpha_1 y(0) + \alpha_2 y'(0) + \alpha_3 y(1) + \alpha_4 y'(1) + \alpha_5 y''(0) &= 0 \\ \beta_1 y(0) + \beta_2 y'(0) + \beta_3 y(1) + \beta_4 y'(1) + \beta_5 y''(1) &= 0,\end{aligned}$$

where the  $\alpha$ 's and  $\beta$ 's are real constants and  $p(x)$  is a real, continuous function on  $0 \leq x \leq 1$ . By referring to the differential equation the boundary conditions may be written in an alternate form in which the parameter  $\lambda$  appears in the coefficients. The developments consist in determining the existence and properties of the eigenvalues, expansion of an arbitrary function in a series of eigenfunctions, the determination of boundary value problems which involve the eigenvalue problem, and the development of an associated integral transform.

The first three of the four chapters deal with the problem when  $\alpha_3 = \alpha_4 = \beta_1 = \beta_2 = 0$ . In Chapter I the orthogonality relation for eigenfunctions is obtained and the following developments include proofs that, under certain conditions, the eigenvalues are real, simple, and positive (or non-negative).

A Green's function solution for the corresponding non-homogeneous problem is obtained, the form of which is an inner product defined to "agree" with the orthogonality relation. Bessel's inequality is proved as is the existence of and a minimal property for eigenvalues. The minimal property and the existence is proved by the use of Rayleigh's quotient defined in terms of the inner product.

In Chapter II two expansion theorems are proved. The first of these is proved by establishing the Parseval's relation from the minimal property for eigenvalues of Chapter I. The second theorem is proved by the use of the theory of the Laplace transform applied to a physical problem in transient heat. Both theorems apply in the case of the differential equation with non-constant coefficients (i.e., when  $p(x) \neq 0$ ).

Chapter III deals with the integral transform whose kernel is the solution of the eigenvalue problem. The transform is developed by showing how it neatly resolves a certain general boundary value problem, the solution of which is not readily obtained by known integral transforms. The formal solution of the boundary value problem is obtained in infinite series form. Some properties of the transform are obtained. Finally, a steady-state physical problem in heat conduction is proposed and a formal solution obtained by application of the transform.

In Chapter IV the beginning steps are taken toward the complete study of the eigenvalue problem in which the coefficients  $\alpha_3$ ,  $\alpha_4$ ,  $\beta_1$ , and  $\beta_2$  are not all zero. Self-adjointness of the problem is discussed

and the orthogonality relation is obtained for a given criterion for the independence of the boundary conditions. A physical problem in transient heat is proposed, the formulation of which gives rise to a special case of the eigenvalue problem. This is the problem of the classical Fourier ring which, however, is split at a point and the ends placed in contact with a well-stirred liquid. An expansion theorem for this case is obtained through the use of the theory of the Laplace transform.

Microfilm copy of complete manuscript of 113 pages, \$1.41. Enlargements 6" x 8", 10¢ per page.

## INTEGRALS ON SPACES OF FUNCTIONS WHICH ARE REAL AND CONTINUOUS ON FINITE AND INFINITE INTERVALS

(Publication No. 3156)

Elizabeth Hahnemann Cuthill, Ph.D.  
University of Minnesota, 1951

The problem which led to this thesis is that of combining Wiener-type integrals defined on adjacent intervals. The Wiener integral\* is defined over the space of continuous functions on the interval  $[0,1]$  which vanish at 0, so that first we define an integral similar to it, but over the space  $C[a,b]$  of continuous functions on the interval  $[a,b]$  which vanish at  $a$ . For  $b$  finite and infinite, respectively, the following transformations relate these integrals to the Wiener integral:

$$\begin{aligned}(1) \quad \int_{C[a,b]} F[x(\cdot)] dx &= \int_{C[0,1]} F[\sqrt{b-a} y\left(\frac{(\cdot)-a}{b-a}\right)] dy, \\ (2) \quad \int_{C[a,\infty)} F[x(\cdot)] dx &= \int_{C[0,1]} F\left[\sqrt{\frac{\pi}{2}} \int_0^{\frac{x(\cdot)}{\sqrt{2}}} \sec \frac{\pi}{2} t dy(t)\right] dy\end{aligned}$$

The transformation in (2) is given in Wiener's paper.\* Using these relations, properties of integrals over  $C[a,b]$  for  $b$  finite and infinite are found from corresponding properties of Wiener integrals. For example, the translation theorem is obtained in this way for integrals over continuous functions on arbitrary intervals. On  $C[a,\infty)$  it becomes

$$\begin{aligned}&\int_{C[a,\infty)} F[x(\cdot)] dx = \\ &\exp\left[-\sqrt{\frac{\pi}{2}} [x'_0(t)]^2 dt\right] \int_{C[a,\infty)} F[x(\cdot) + x'_0(\cdot)] \exp\left[-2 \int_a^{x'_0(t)} dx(t)\right] dx\end{aligned}$$

where  $x'_0(t) \in C[a,\infty)$  is absolutely continuous on every finite subinterval of  $[a,\infty)$  and  $x'_0(u) \in L_2[a,\infty)$ .

When  $b$  is infinite, conditions are found whereby the integral can be obtained by taking the limit of a sequence of integrals over continuous functions on finite intervals. For example, such a set of conditions is given in the following theorem:

Suppose  $F(x)$  is defined on  $C[a,\infty)$  and is measurable on  $C[a,n]$  for all integers  $n > a$ . [If  $x(t) \in C[a,n]$ , then  $x(t) = x(n)$  for  $t > n$ .] Suppose further that  $F(x)$

is continuous in the topology where we define  $d(x,y)$  to be

$$\left[ \int_a^\infty \alpha(t) [x(t)-y(t)]^2 dt \right]^{1/2}$$

where  $\alpha(t) \geq 0$ ,  $\alpha(t)$  is summable on  $[a, \infty]$ , and for some  $\delta > 0$ ,  $b > 0$ ,  $\alpha(t)t^{1+\delta}$  is summable on  $[b, \infty]$ . Suppose also that for all sufficiently large  $n$  and for all  $x \in C[a, \infty]$  for which the integral is finite,

$$|F(x)| \leq \exp \left[ \lambda \int_a^\infty (t-a)^{-4} x^2(t) dt \right]$$

where  $\lambda < \pi^2(a-\alpha)^2$  and  $\alpha < a$ . Then

$$\lim_{n \rightarrow \infty} \int_{C[a,n]} F(x) dx = \int_{C[a,\infty]} F(x) dx.$$

The integral of a functional defined for continuous functions on the interval  $[a,b]$  which vanish at  $a$  can be expressed as an integral over a product space  $C[a,c] \otimes C[c,b]$  where  $a < c < b$  as follows:

$$\int_{C[a,b]} F(x) dx = \int_{C[a,c] \otimes C[c,b]} F(y+z) d(y) d(z).$$

Here  $y(\cdot)$  is understood to be any continuous function vanishing at  $a$  whose definition is so extended that

$$y(t) = \begin{cases} 0 & \text{for } t < a \\ y(b) & \text{for } t > b, \end{cases}$$

and similarly for  $z$ . Using this, it can be shown that a multiple Wiener integral can always be expressed as a single Wiener integral. In the case of the double integral, we have the following:

$$\int_{C[0,1] \otimes C[0,1]} F(x,y) d(x \otimes y) = \int_{C[0,1]} F\left\{ a^{-1/2} z[(\cdot)a], (1-a)^{-1/2} (z[(1-a)(\cdot)+a] - z(a)) \right\} dz, \quad 0 < a < 1.$$

The Lindgren integral\*\* is defined over all continuous functions on  $[0,1]$ . Here it is generalized to an integral defined over all continuous functions on  $[a,b]$  ( $a$  may be  $-\infty$ ,  $b$  may be  $+\infty$ ). When  $a$  is finite, this integral is related to the Wiener integral as follows:

$$\int_{C[a,b]} F(x) dx = \int_{C[a,b]} F(y+\xi) d(y \otimes \xi) \quad E_1$$

where  $E_1$  represents the one-dimensional Lebesgue space. Relations analogous to (1) and (2) are obtained for the Lindgren integral and can be used to obtain properties of this integral on arbitrary intervals from those on  $[0,1]$ . This is done, for example, for the translation theorem and for the evaluation of integrals of functions of Stieltjes integrals.

\* See N. Wiener, Generalized harmonic analysis. Acta Math. 55, pp. 117-258 (1930).

\*\* See B. Lindgren, Thesis, University of Minnesota, 1949. Microfilm copy of complete manuscript of 117 pages, \$1.46. Enlargements 6" x 8", 10¢ per page.

## INVESTIGATIONS ON FINITE GROUPS OF EVEN ORDER

(Publication No. 3496)

Kenneth Arthur Fowler, Ph.D.  
University of Michigan, 1952

One of the basic problems in group theory is to characterize the simple groups. A related problem is to find conditions for the existence of normal subgroups of an arbitrary group. Very little is known concerning either question.

In this dissertation only finite groups of even order are investigated. One reason for this limitation is that such groups seem to be of special importance, in view of the fact that all known simple groups, which are not cyclic, are of even order. Moreover, there is a conjecture of long standing to the effect that every non-cyclic simple group is of even order.

A second reason for this limitation is that a method is obtained which gives results for groups of even order, and which does not seem to have any analogue for groups of odd order. The method consists in working with the multiplication of the classes of conjugate elements of order 2, these classes being interpreted as elements in the group algebra.

Certain results of Jordan, Frobenius, and Schur on linear groups, taken together with results derived by the method mentioned above, yield the following theorem: If  $r$  denotes the number of elements in a group  $G$  which commute with a given element of order 2, then  $G$  properly contains a normal subgroup of bounded index, the bound depending only on  $r$ . Actually, a stronger result can be obtained. In the conclusion of the theorem,  $r$  can be replaced by  $g/m$ , where  $g$  is the order of  $G$  and  $m$  is the number of elements of order 2 which are contained in  $G$ .

In connection with the above theorem, the most simple case is that in which  $G$  contains no element of order  $2p$  for  $p$  an odd prime. Groups with this property are studied, and it is shown that the order  $g$  of such a group must lie below a bound which depends only on the highest power of 2 which divides  $g$ . If the further assumption is made that the Sylow subgroups  $P$  of order  $2^a$  are Abelian, then one of the following cases must hold: 1)  $P$  is a normal subgroup of  $G$ ; 2)  $P$  is cyclic and  $G$  contains a normal subgroup of index  $2^a$ ; 3)  $G$  is isomorphic to the linear fractional group  $LF(2,2^a)$  consisting of all matrices of degree 2 and determinant 1 with coefficients in the Galois field with  $2^a$  elements. This result can be considered as a characterization of the class of simple groups  $LF(2,2^a)$ .

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**CONFORMALLY FLAT HYPERSURFACES  
OF SPACES OF CONSTANT CURVATURE**

(Publication No. 2954)

John H. Giese, Ph.D.  
Princeton University, 1940

Abstract not available.

Microfilm copy of complete manuscript of 106 pages, \$1.33. Enlargements 6" x 8", 10¢ per page.

**A LINEAR ALGEBRAIC THEORY OF COMPLEXES**

(Publication No. 2985)

Lloyd Wayne Johnson, Ph.D.  
Princeton University, 1941

Abstract not available.

Microfilm copy of complete manuscript of 46 pages, \$1.00. Enlargements 6" x 8", 10¢ per page.

**AN INTEGRAL FORMULA FOR ANALYTIC  
FUNCTIONS OF  $k$  VARIABLES  
WITH SOME APPLICATIONS**

(Publication No. 3007)

Donald Curtis May, Jr., Ph.D.  
Princeton University, 1941

Abstract not available.

Microfilm copy of complete manuscript of 83 pages, \$1.04. Enlargements 6" x 8", 10¢ per page.

**FOURIER SERIES ON COMPACT GROUPS**

(Publication No. 3547)

Gustave Rabson, Ph.D.  
University of Michigan, 1952

The Peter-Weyl theorem asserts that if  $G$  is a compact group then the matrix elements of a complete system of inequivalent irreducible unitary representations form a complete orthogonal system of functions in the Hilbert space of complex-valued square-integrable functions defined on  $G$ . When  $G$  is the circle (the real numbers modulo  $2\pi$ ) then it is easy to show that the irreducible representations are all one-dimensional and are in fact the function  $e^{inx}$  where  $n$  is any integer. The theorem then asserts that the Fourier series (in the complex form) of any complex-valued function in  $L^2$  converges in the mean to that function. One sees that the Peter-Weyl theorem gives a generalization of the idea of Fourier series to compact topological groups and it asserts the  $L^2$  convergence of this Fourier series.

It is the purpose of this dissertation to study, by methods similar to those in the classical case, the problem of determining sufficient conditions for the

convergence (pointwise, uniform and unconditional) of the Fourier series on general compact groups and to study the possibility of using summation methods to reconstruct the function from its Fourier coefficients.

Generalizations of the ideas of the Dirichlet kernels and the Lebesgue constants are introduced in Part I and the theorem (essentially due to Lebesgue) that if the Lebesgue constants are unbounded then there must exist continuous functions whose Fourier series diverge is proved.

It is also proved that if a function on a compact semi-simple Lie group is sufficiently differentiable then its Fourier series will converge absolutely.

In Part II of this dissertation the theory of Fourier series on the group of quaternions of norm 1 is studied in some detail. It is proved that the Lebesgue constants are of order  $n$ . Analogues of Fejér's theorem are proved using (C,2) summability, (C,3) summability and Abel summability. For (C,3) summability the positivity of the kernel was previously proved by Fejér. For (C,2) summability the kernel is not positive. It is also shown that (C,1) summability cannot be enough. We also prove an analogue of a theorem of Kolmogoroff which states that certain subsequences of the sequence of partial sums of the Fourier series of a function in  $L^2$  will converge almost everywhere, in particular if  $n_{k+1}/n_k > \lambda > 1$  then the sequence  $S_{n_k}$  will converge almost everywhere.

It is shown in paragraph 2.5 that the localization theorem does not hold even for a class function which consists of two constant portions. This seems rather surprising in view of the fact that the behavior of the character series of a class function is intimately related to the behavior of the character series on a maximal abelian subgroup which, in the case of the group of quaternions of norm 1, is a circle.

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**CONNECTEDNESS AND COHERENCE**

(Publication No. 3047)

Arthur Harold Stone, Ph.D.  
Princeton University, 1941

Abstract not available

Microfilm copy of complete manuscript of 153 pages, \$1.91. Enlargements 6" x 8", 10¢ per page.

**ON DENUMERABILITY IN TOPOLOGY**

(Publication No. 3056)

John Wilder Tukey, Ph.D.  
Princeton University, 1939

Abstract not available

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## MEDICINE

**CAUSES OF FETAL AND NEONATAL DEATH  
WITH SPECIAL REFERENCE TO PULMONARY  
AND INFLAMMATORY LESIONS**

(Publication No. 3404)

James Blanding Arey, Ph.D.  
University of Minnesota, 1951

An adequate anatomic cause of death was demonstrated in 107 of 137 fetuses and infants who died during the neonatal period; anatomic causes of death were demonstrable in 87 (85 per cent) of the 102 live-born infants and in 20 of the 35 stillborn fetuses.

Intrauterine anoxia, as evidenced by aspiration of excessive amounts of the contents of the amniotic sac, was the single leading cause of death, accounting for 16 per cent of the fetal and neonatal deaths. From the available evidence, it is concluded that repeated deep intrauterine respiratory movements with resultant aspiration of large amounts of amniotic debris are not a normal occurrence and that the presence of large amounts of amniotic debris in the lungs is evidence of fetal anoxia. Fetuses and infants dying as a result of fetal anoxia probably do so as the result of cerebral damage and not primarily as a result of the inhalation of amniotic debris.

Intrapulmonary hyaline membranes were the leading cause of death in liveborn infants, accounting for the deaths of 15 premature infants; such membranes were not observed in stillborn fetuses. The pathogenesis of these intrapulmonary hyaline membranes is discussed. Although no conclusions are reached as to the nature of the material comprising the membranes, evidence is advanced to support the concept that vascular damage and increased capillary fragility may play a role in their origin.

Major congenital anomalies were responsible for the deaths of 14 fetuses and infants, and major or potentially lethal anomalies were present in 3 other patients. More than one anomaly was present in over 50 per cent of those fetuses and infants whose deaths were attributed to congenital anomalies. Minor congenital anomalies, some of which might assume clinical significance somewhat later in life, were often present in the absence of any major anomaly.

Intraventricular hemorrhage was the single leading cause of death of preivable premature liveborn infants. Although other factors play a part in their pathogenesis, prematurity is certainly the most important factor predisposing to intraventricular hemorrhage.

Bronchopneumonia was considered responsible for the deaths of 10 liveborn infants and was present in 29 other non-syphilitic fetuses and infants. Although some examples of intrauterine pneumonia may be secondary to aspiration of sterile, but irritating, contents of the amniotic sac, many are probably due to the aspiration of amniotic fluid which has been contaminated by bacteria. There was a significant increase in the incidence of pneumonia, presumably developing in utero, following prolonged labor or aspiration of excessive amounts of amniotic debris.

Congenital syphilis was responsible for 9 fetal and neonatal deaths. Splenomegaly, syphilitic osteochondritis, and extramedullary hematopoiesis were the most constant abnormalities found in these patients, followed by syphilitic pancreatitis, moderate hepatomegaly, and syphilitic inflammation of the lungs. Other less frequent findings included syphilitic involvement of the leptomeninges, bowel, adrenals, and hypophysis.

Intracranial trauma, as manifested by tears of the dural septa with or without subdural hemorrhage, was responsible for 7 fetal and neonatal deaths. Many tears of the dural septa probably heal spontaneously and give rise to no definite symptoms; the subdural hemorrhage which may accompany dural tears is the usual cause of death.

Kernicterus was considered to be the primary cause of death in 5 liveborn infants and was present as a contributory cause in 4 other infants. The available evidence suggests that some of these infants represent examples of kernicterus occurring in non-erythroblastotic infants.

In approximately one-third of the fetuses and infants for whom maternal records were available and in whom no anatomic cause of death could be demonstrated, the maternal records suggested intrauterine anoxia as the cause of death.

Prematurity, uncomplicated by other disorders, is seldom the sole cause of death. Careful postmortem examinations will reveal, in addition to immaturity, a cause of death in the majority of premature infants dying during the neonatal period.

Inflammatory lesions, many of which are probably infections in origin, play an important role as primary and contributory causes of death in the neonatal period; they were present in 52 per cent of the liveborn infants in this series.

Histologic examination of multiple sections of the lungs is an essential part of any postmortem examination of a fetus or newborn infant. In this series, histologic examination of the lungs alone would have indicated the cause of death in 35 per cent of the fetuses and infants. The pulmonary lesions encountered are frequently indicative of the cause of death, but only can be interpreted properly when correlated with the clinical record and with the findings of a complete postmortem examination. Further studies are necessary to a better understanding of the pathogenesis and significance of many of the commonly observed pulmonary lesions.

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**SPINA BIFIDA AND CRANUM BIFIDUM  
A CLINICO-PATHOLOGICAL STUDY**

(Publication No. 3406)

Robert George Fisher, Ph.D.  
University of Minnesota, 1951

An investigation was made of 530 cases of spina bifida and cranium bifidum seen at the Mayo Clinic

from 1910 to 1945. An extensive clinical, pathological, radiological, and experimental study was made. Included in the series were 242 males and 288 females and the age group ranged from birth to fifty-nine years. Of the total admissions to the Mayo Clinic, an average of 3.6 cases of spina bifida per 10,000 patients was seen. Extensive follow-up studies were carried out and these ranged from two to forty years. Cases of spina bifida occulta were excluded.

A review was made of the historical background of spina bifida and its complications. The normal embryology of the central nervous system was then reviewed in detail to attempt to correlate abnormalities seen in extrauterine life with possible abnormalities that might occur in the first trimester of pregnancy. A review was made of the total methods of producing spina bifida experimentally and an attempt was made by the use of trypan blue injected into rats after the method of Gillman and coworkers (80) to see if the abnormality could be produced. This was unsuccessful. A very extensive study of the pathology of spina bifida was made. Ninety-two resected meningocele sacs were investigated for evidences of heterotopia and other abnormalities of the central nervous system. The entire central nervous system of forty-two general autopsy specimens was reviewed. This included the resected sac if possible, spinal cord, medulla oblongata, cerebellum, pons, midbrain, and cortex if available. The studies indicated that extensive central nervous system derangement is existent in addition to an abnormal sac. Many of the cord specimens showed evidences of syringomyelia, hydromyelia, or both. Heterotopia was common in various locations in the central nervous system. Serial sections were then made of three cord specimens, indicating extensive changes serially in a microscopic examination. Comprehensive clinical investigation was carried out with particular interest centered on abnormalities present, time of resection of sacs, type of surgery, abnormalities of pregnancy, and ultimate long range results. No definite conclusions were reached as to the optimum time for surgery to be performed. No investigation was made of tissue the origin of which was other than that of the ectoderm.

Extensive radiological study was carried out and abnormalities of the skull, as well as the spine, were found, and discovered extensively in certain specimens. A review was made of cases of spina bifida with complications, such as neurologic disability and hydrocephalus, and the effects which surgery or conservative therapy might have upon the development of these complications in the future. It was found that the cases of cranium bifidum had fewer complications than the cases of spina bifida. However, uncomplicated cases of meningocele without central nervous system protrusion had a far better prognosis ultimately than those of meningomyeloceles. There seemed to be a much greater tendency for patients with meningomyeloceles to develop hydrocephalus and the intelligence, in general, appeared to be greater in meningoceles than in the cases of meningomyeloceles. Follow-up studies covered on the average six and one-half years for 366 cases.

Microfilm copy of complete manuscript of 207 pages, \$2.59. Enlargements 6" x 8", 10¢ per page.

#### STUDIES IN WOUND HEALING OF THE AORTA WITH SPECIAL REFERENCE TO PROBLEMS OF ANASTOMOSIS AND GRAFTING TECHNIC

(Publication No. 3201)

Yoshio Sako, Ph.D.  
University of Minnesota, 1951

The early and recent history of the development of vascular surgery was reviewed. Certain differences of opinion regarding techniques of aortic suture were considered and evaluated in the experimental animal.

A brief review of the history of transplantation of tissue was made. The evidence at hand suggested that homologous artery and vein grafts whether fresh or preserved undergo degenerative changes after being transplanted into the host, whereas autogenous artery and vein grafts have a high survival rate. For these reasons the use of autogenous tissue grafts to bridge major artery defects was further investigated.

#### Experimental Procedure and Results

##### A. Aortic Suture Methods:

Suture anastomoses of the transected thoracic aorta in dogs were performed by the following methods:

1. End-on coaptation with a continuous suture through all layers.
2. End-on coaptation with suture avoiding piercing the intima.
3. End-on coaptation with eversion of the vessel ends with a continuous mattress suture through all layers.

The suture material used were 6-0 braided silk, 5-0 and 6-0 catgut.

A total of 85 dogs were operated upon. Gross examination, intraluminal pressure tests, and microscopic examinations have led to the following conclusions:

1. Sutured aortas were able to withstand intraluminal pressures of more than twice physiologic limits from the very first post-operative day regardless of method employed.
2. Incidence of hemorrhage and thrombus formation was low and appeared to have no relation to suture material used or technic of anastomosis.
3. In vessels anastomosed with a continuous silk suture without eversion of vessel ends, the silk remained intact for periods up to one year whereas mattress type sutures tended to pull through the vessel wall.
4. Anastomoses performed in puppies demonstrated retardation of growth of the site of anastomosis.
5. Microscopic sections demonstrated rapid bridging of the site of anastomosis with fibrin and endothelial bridge. Silk sutures were covered with endothelial growth by the 10th day.

6. The smoothest end results were obtained with end-on coaptation without eversion of vessel ends with catgut sutures.

**B. Autogenous Tissue Grafts in the Thoracic Aorta:**

Pericardial tissue was sutured into tubular form 3-4 cm. long and corresponding to the size of the transected thoracic aorta and sutured into place with 6-0 silk to bridge the defect. Subsequent serial aortograms demonstrated fusiform dilatation of these grafts. Successful prevention of the dilatation of the pericardial grafts was obtained with a fascia lata buttress to the pericardial grafts. Limited experience with fascia lata only to bridge aortic defects showed fascia alone to be unsatisfactory because of dilatation of the graft.

Results of vein grafts obtained from the inferior vena cava and transplanted into the thoracic aorta confirmed the observation of previous investigators, namely that the grafts undergo fusiform dilatation especially in grafts longer than 1 1/2 cm. to 2 cm. long. The dilatation of these grafts was prevented with a buttress of fascia lata. Moderate success was also obtained with dermis as a buttress for the prevention of dilatation of the venous grafts.

Periodic X-ray, gross and microscopic examinations have led to the following conclusions:

1. Pericardial tube grafts up to 4 1/2 cm. long can serve successfully to bridge defects of a major artery.
2. All pericardial grafts undergo endothelialization with ingrowth of cells from the adjacent aorta.
3. Fusiform dilatation of pericardial grafts was an undesirable feature but this was prevented with fascia lata grafts as a buttress around the pericardial graft.
4. Vein grafts placed into the thoracic aorta undergo fusiform dilatation but this could be prevented with a fascia lata jacket incorporated into the graft.
5. Limited experience with dermis suggested that the latter may serve as a buttress material in place of fascia lata.
6. Microscopic sections showed that all autogenous grafts of pericardium, fascia, vein, and dermis demonstrated degenerative changes and gave evidences of viability for periods up to 1 1/2 years post-operatively.

Microfilm copy of complete manuscript of 133 pages, \$1.66. Enlargements 6" x 8", 10¢ per page.

## MINEROLOGY

### STABILITY RELATIONS OF FERRIC OXIDES AND THEIR HYDRATES.

#### LIPSCOMBITE: A NEW SYNTHETIC "IRON LAZULITE" (Publication No. 3162)

Mohamed Ahmed Gheith, Ph. D.  
University of Minnesota, 1951

In the system  $\text{Fe}_2\text{O}_3\text{-H}_2\text{O}$  where solubilities are very low and reaction rates extremely slow, the following relations exist.

1. Lepidocrocite changes to hematite at temperatures as low as  $95^\circ\text{C}$  under saturated steam or lower pressures. Between roughly  $170^\circ\text{C}$  to  $400^\circ\text{C}$ , gamma- $\text{Fe}_2\text{O}_3$  is obtained only under atmospheric or lower pressures provided water vapor escapes freely.

2. Various organic substances reduce all ferric oxides and oxide hydrates to magnetite at high temperatures. If this magnetite is cooled slowly in an oxidizing atmosphere, it changes to gamma- $\text{Fe}_2\text{O}_3$ .

Differential thermal analysis shows two exothermic peaks for synthetic magnetite, and only a single exothermic plateau which starts at about  $635^\circ\text{C}$  and does not end even at  $1100^\circ\text{C}$  for natural magnetite.

3. In the presence of water vapor gamma- $\text{Fe}_2\text{O}_3$  changes to hematite at temperatures as low as  $95^\circ\text{C}$ . The catalytic action of steam on this transformation was quantitatively studied.

4. Both types of colloidal ferric oxide hydrate — the brown and the yellow gels — are amorphous when fresh. The rate of formation of goethite on aging is much faster in the yellow than in the brown gel. Differential thermal analysis of both fresh gels shows direct crystallization to hematite. With aged gels the presence of goethite is indicated.

5. The decomposition temperature of goethite in pure water is confirmed by more than one method to be around  $130.5^\circ\text{C}$ . It depends on the nature and concentration of the ions present in the surrounding solutions, and not on the pH of those solutions as has been hitherto assumed. This seems to be the case in the dehydration of lepidocrocite to hematite.

6. The effect of pressure is generally of a small order.

7. Siderite was synthesized and its oxidation products determined under various laboratory conditions.

#### LIPSCOMBITE: A NEW SYNTHETIC "IRON LAZULITE"

Lipscombite was obtained both by the partial oxidation of ferrous phosphate and by the combination of suitable ferrous and ferric salts. Beta-lipscombite forms black shiny flattened bipyramids, with a dark green streak. It is tetragonal trapezohedral, having a defect structure and a unit cell containing 4P, 16O, 4OH and a number of iron ions theoretically varying from  $8\text{Fe}^{2+}$  to  $5 \frac{1}{3}\text{Fe}^{3+}$ , with the density (calculated) correspondingly varying from 4.02 to 3.36. Alpha-lipscombite, like lazulite, is probably monoclinic, having the composition  $\text{Fe}^{2+}\text{Fe}^{3+}(\text{PO}_4)_2(\text{OH})_2$ .

When alpha-lipscombite is heated, it changes to beta-lipscombite between  $110$  and  $290^\circ\text{C}$ . Above  $290^\circ\text{C}$  beta-lipscombite contains no divalent iron. At or slightly below  $560^\circ\text{C}$  beta-lipscombite changes to "iron berlinit" and hematite. At still higher temperatures an unknown compound forms at the expense of both hematite and iron berlinit. When ferrous phosphate is heated in open air, it is dehydrated and oxidized to a yellow amorphous ferric phosphate below  $110^\circ\text{C}$ . This product crystallizes at about  $560^\circ\text{C}$  to hematite and "iron cristobalite" and the unknown compound mentioned above. On further heating iron cristobalite is converted to iron berlinit below  $650^\circ\text{C}$ .

The ferrous iron of beta-lipscombite can be replaced easily by other divalent metals, resulting in minor changes in the x-ray powder photographs. No regular decrease in the unit cell size, however, could be detected with decreasing sizes of replacing ions. The replacement of ferric iron by aluminum takes place only partially and with difficulty.

Microfilm copy of complete manuscript of 162 pages, \$2.03. Enlargements 6" x 8", 10¢ per page.

## MUSIC

### **BASES FOR ARTICULATION BETWEEN THE HIGH SCHOOLS OF MICHIGAN AND THE SCHOOL OF MUSIC OF THE UNIVERSITY OF MICHIGAN**

(Publication No. 3495)

William David Fitch, Ph. D.  
University of Michigan, 1952

One of the major problems in education today is that of effective coordination between secondary education and higher education. There is now a strong movement to seek better relationships between the educational programs of high schools and colleges. The purpose of this study is to find bases for such articulation between the high schools of Michigan and the School of Music of the University of Michigan.

The method used consists of a study of the activities engaged in by student applicants, their high schools, and the University of Michigan, leading to admission of students to the School of Music of the University, and of student success during the freshman year. The study is limited to those graduates of Michigan high schools who entered the School of Music in September, 1950.

The plan for the solution of the problem is to compare and evaluate data taken from four separate studies: 1) data from folders of 51 freshmen students who entered the School of Music in September, 1950, 2) data from personal interviews with each of these 51 students, 3) data from checklists returned by 42 parents of students in this study, and 4) data from checklists returned by 38 high school principals or counselors of students in this study.

In addition to these data, the study contains a review of related literature, and a history of admission requirements for the School of Music since the year 1912.

The results obtained from the study indicate the following:

1. Freshmen selected by the School of Music possess superior qualifications of training and scholarship.
2. Students receive the most influence to attend the University through conferences with their private music teachers.
3. Students receive the most information about the University from University catalogs.
4. Students receive little help or guidance from high school authorities in the selection of a college music curriculum or field of concentration.

5. Students receive the most help or guidance in college from their classroom teachers and from other students.

6. Courses in English, theory, and music literature cause the most difficulty to students in this study, and students judge their high school preparation for these subjects inadequate on the basis of their college experience.

7. Freshmen in this study are successful as college students.

Conclusions drawn from this study indicate four areas which need closer articulation between high schools of Michigan and the School of Music of the University of Michigan:

1. Closer working relations are needed between the subject matter offered in high schools and that offered in the University.

2. Adequate guidance should be furnished to students early in their musical careers. This should include information about vocational possibilities in the various fields of concentration within the School of Music.

3. Private applied music teachers should receive much consideration as a means of effective pre-college guidance for students.

4. A clearer understanding is needed by high school administrators and parents as to the purpose and function of the School of Music and its fields of concentration.

Microfilm copy of complete manuscript of 300 pages, \$3.75. Enlargements 6" x 8", 10¢ per page.

## PHARMACOLOGY

### **STUDIES ON THE IN VIVO AND IN VITRO METABOLISM OF 5-ETHYL-5(1-METHYL BUTYL)-2-THIOBARBITURIC ACID (THIOPENTAL) BY THE RAT**

(Publication No. 3504)

Thelma Bernice Clark Gould, Ph. D.  
University of Michigan, 1952

The experiments reported in this thesis include a study of the distribution of thiopental in the tissues of the rat; a determination of the rate of metabolism of the compound in the rat in vivo, including a study of the effects of hepatectomy and nephrectomy on this rate; and, an attempt to define the enzymatic system or systems involved in the in vitro metabolism of thiopental by rat liver.

Equilibrium of thiopental between tissues and blood was found to occur within one minute for liver and brain but not until one to two hours for adipose tissue. After equilibrium was established concentration ratios for brain, liver and fat were, respectively, 0.6, 2.5 and 6.6.

The in vivo rate of metabolism of thiopental appeared to be linear for the first 6 hours, at the rate of 10 per cent per hour based on administered dose. After 6 hours the rate of metabolism diminished;

approximately 90 per cent of the compound was metabolized in 12 hours, and 99 to 100 per cent by 22 hours. Partial hepatectomy produced striking inhibitory effects on the ability of rats to metabolize thiopental; bilateral nephrectomy was less striking, though effective.

The *in vitro* metabolism of thiopental by a fortified, cell-free homogenate of rat liver was stimulated by the addition of intermediary metabolites (particularly  $\alpha$ -ketoglutarate, succinate, fumarate or malate) and of cofactors, — adenosine triphosphate, cytochrome c and nicotinamide. The reaction was inhibited by cyanide. Addition of dinitrophenol, in concentrations which completely suppressed the formation of phosphocreatine by this system, inhibited thiopental metabolism 30 per cent. Using succinate as a substrate, thiopental metabolism was completely inhibited by the addition of antimycin A, a potent succinoxidase inhibitor. The addition of malonate, however, did not depress the metabolism of thiopental, although the oxygen uptake of the system was inhibited almost completely. Supplementing the system with malonate, in place of succinate, stimulated the metabolism to an extent comparable to that resulting from supplementation with any of the Krebs cycle intermediates.

A study of the activity of fractions of liver homogenate resulting from centrifugation in the cold (500 to 2400 r. p. m.) revealed a high degree of activity in the heavy particulate fraction.

Microfilm copy of complete manuscript of 66 pages, \$1.00. Enlargements 6" x 8", 10¢ per page.

#### ON THE NATURE OF TACHYPHYLAXIS TO ATROPINE ACQUIRED BY INTESTINAL SMOOTH MUSCLE

(Publication No. 3505)

Grace Warner Gray, Ph. D.  
University of Michigan, 1952

It has been observed that frequently repeated administrations of atropine produce rapidly diminishing effects on intestinal motility in the dog. An investigation of the nature and mechanism of this tachyphylaxis phenomenon was undertaken, utilizing balloon recording techniques in unanesthetized dogs with intestinal fistulae, and various *in vitro* smooth muscle preparations.

The action of atropine on dog intestinal motility was first characterized. It was confirmed that atropine depresses tone and contractile activity, the inhibitory effect being more profound and prolonged in chronically "denervated" intestine. The inhibitory response was correlated with cholinergic blockade. Atropine never produced complete inhibition of normal small intestinal activity, and it failed to block the effects of parasympathetic nerve stimulation.

Investigation of atropine tachyphylaxis revealed that the phenomenon may be demonstrated at any level of the intestinal tract, and that the pattern which it assumes may be varied by the manipulation of doses,

routes of administration, and time intervals. Tolerance development was shown to be independent of the central nervous system, although chronically "denervated" intestine exhibited less capacity for atropine-refractory activity than did normally innervated intestine. Acute tolerance to atropine was also demonstrated in dog and rabbit intestine *in vitro*.

After a given dose of atropine, cholinergic blockade was found to persist long after the inhibitory response had terminated. The duration of the tolerant state paralleled the duration of cholinergic blockade, both being dependent on the initial dose. Atropine-resistant activity could be produced, independent of inhibition, by very gradual administration of the drug. Cholinergic blockade by atropine was shown to be a competitive phenomenon. The tolerant state was non-competitive in that, once established, it could not be overcome by any dose of atropine, nor by alteration of the cholinergic blockade with high doses of methacholine.

Studies with other antispasmodic drugs of various types indicated that only those drugs possessing cholinergic blocking activity were capable of exhibiting tachyphylaxis in the intestine, and that cholinergic blocking potency paralleled capacity to stimulate atropine-refractory activity. Chemical similarity to atropine was not a prerequisite for tachyphylactic capacity, but all drugs exhibiting tachyphylaxis also showed crossed tolerance with atropine.

Attempts to alter the development of atropine tachyphylaxis by administration of atropine hydrolysis products, posterior pituitary, ACTH, epinephrine, methacholine, potassium, or ganglionic blocking agents were not successful. However, many of these agents altered intestinal functioning in other interesting ways.

*In vitro* experiments revealed that completely denervated intestinal smooth muscle, and segments of intact intestine, are stimulated to rhythmic activity by various quaternary ammonium compounds, some of which are antagonized by atropine (choline, acetylcholine) while others are not (TEA). Upon standing, isolated intestine releases into the surrounding medium unidentified excitatory substances, not antagonized by atropine, which are capable of initiating and maintaining rhythmic contractions in inactive segments.

It is felt that atropine tachyphylaxis represents progressive receptor occupation by the drug, in the face of an active augmentation of the intestine's inherent capacity for atropine-resistant activity. Various theories as to the nature of atropine-refractory motility have been considered.

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**THE RELATION BETWEEN INTERRUPTION OF  
THE TRICARBOXYLIC ACID CYCLE AND  
THE PHARMACOLOGIC ACTION OF  
SOME FLUORO-FATTY ACIDS**

(Publication No. 3517)

Alexander Kandel, Ph.D.  
University of Michigan, 1952

It has been shown that fluoroacetate will inhibit acetate metabolism as well as citrate removal in vitro and in vivo. The convulsive activity and cardiac disturbances in various species of animals, and the tolerance to fluoroacetate sometimes observed, have been attributed to abnormally high levels of intracellular citrate. These ascriptions have been investigated with the object of relating convulsive activity and cardiac abnormalities to citrate accumulation induced by fluoro-fatty acids.

Various experimental procedures have been employed. The electroencephalogram was used to mark central nervous system disturbances, and the electrocardiogram, cardiac abnormalities, at which points the animals (dogs and monkeys) were sacrificed and citrate content of appropriate tissue determined. Rats were treated with the fluoro-fatty acids and sacrificed during initial convulsions or at appropriate times, by decapitation, and brain citrate levels determined. Glycerol monoacetate, which antagonizes fluoroacetate, was used principally to determine its effect on brain citrate accumulation in fluoroacetate-poisoned rats. Other experiments, with rats exclusively, were performed to determine the effect of large, after small doses, of fluoroacetate and 4-fluorobutyrate, on brain citrate accumulation with respect to tolerance to these poisons.

1. Fluoroacetate, 4-fluorobutyrate and 6-fluorohexanoate cause the accumulation of citrate in the intact animal. 3-Fluoropropionate produces neither citrate nor symptoms of toxicity of fluoro-fatty acid poisoning in dogs.

2. The factors of dosage and duration of poisoning with the fluoro-fatty acids are related to the accumulation of citrate.

3. Glycerol monoacetate (monoacatin) encourages the accumulation of citrate in brain while protecting against fluoroacetate poisoning in rats. It does not protect against 4-fluorobutyrate.

4. Glycerol monobutyrate (monobutyrin) antagonizes 4-fluorobutyrate, but not fluoroacetate, in rats.

5. The citrate which accumulates in rat brain as a result of a small dose of fluoroacetate does not prevent the further formation of citrate when larger doses are given.

6. Small doses of fluoroacetate increase the resistance in the rat to larger challenging doses of fluoroacetate as well as 4-fluorobutyrate, but neither the reciprocal relationship of 4-fluorobutyrate against fluoroacetate, nor that of 4-fluorobutyrate could be obtained.

It may be concluded, therefore, that neither interpretation of the presence of citrate as a toxic ion, nor as an index of a blockade of the tricarboxylic acid cycle can be correlated with the development of the

signs and symptoms of poisoning by these fluoro-fatty acids. The citrate content of rat brain appears to have no relation to the tolerance to fluoroacetate which has been observed.

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**PHILOSOPHY**

**PROLEGOMENA TO A CRITICAL  
THEORY OF VALUE**

(Publication No. 2920)

Robert Walter Bretall, Ph.D.  
Princeton University, 1938

Abstract not available.

Microfilm copy of complete manuscript of 228 pages, \$2.85. Enlargements 6" x 8", 10¢ per page.

**THE SUBSTANTIVAL AND FUNCTIONAL  
THEORIES OF THE CONCEPT**

(Publication No. 2924)

Joseph Caden Burk, Ph.D.  
Princeton University, 1939

Abstract not available.

Microfilm copy of complete manuscript of 56 pages, \$1.00. Enlargements 6" x 8", 10¢ per page.

**POINCARÉ'S CONVENTIONALISM IN GEOMETRY**

(Publication No. 3104)

Joseph Epstein, Ph.D.  
Columbia University, 1951

The development of Non-Euclidean geometries, through the research of Riemann, is reviewed. The infinity of equi-possible geometries of constant and variable curvature, disclosed by this development, provides the central problem to which Poincaré's Conventionalism in Geometry is addressed: which of these geometries is true?

In the examination of the answers given by the Kantian and Empiricist traditions, the generic content of Poincaré's Conventionalism: "one geometry can not be more true than another," is shown to mask three specific Conventionalisms in Geometry. Each is developed and seen to reject some version of Kantianism or Empiricism in geometry.

1. The Kantian answer selects the Euclidean geometry as true on the grounds that, of this infinity of geometries, only the axioms of Euclid are synthetic apriori. This synthetic apriority is shown to imply the psychological impossibility of a non-Euclidean axiom set expressing a necessary synthesis: an

imaginative construction which the human mind is compelled to perform to the exclusion of others, and the psychological impossibility of a non-Euclidean axiom set expressing a universal synthesis: an imaginative construction which we exercise in the apprehension of all appearance.

Poincaré's denial of this consequence is twofold. First, the undeniable inferential development of non-Euclidean axiom sets means, on Kantian grounds, that these do express a necessary synthesis: since, for Kant, a necessary synthesis is essential to any such development. Second, Poincaré shows that it is psychologically possible that non-Euclidean axiom sets express a universal synthesis by constructing a "model world" in which beings with minds like those of human beings would be led to a synthesis in the apprehension of appearance identical with the synthesis expressed by non-Euclidean axioms.

This second part of Poincaré's rejection of the Kantian position evidences the interworking of mathematical and philosophic problems and the foundations of one of the three specific Conventionalisms in Geometry. For this model is an application of a Projective Geometric result: the intertranslatability of any two of the geometries of constant curvature. This intertranslatability determines any interpretation of specific signs of one geometry of such a set of intertranslatable geometries as the interpretation of specific signs of every geometry of the set. Such a set of geometries is called "F-conventional." This Conventionalism underlies Poincaré's dictum: "It is impossible to imagine a concrete experiment which can be interpreted in the Euclidean system and not in the Lobatschefskian. . . ."

2. The Empiricist decision-procedure in terms of the inductive, factual truth of some one geometry is impossible. The sentences of geometry are propositional functions. Since propositional functions are neither true nor false, no geometry is either true or false. Consequently, no geometry can be more true than another.

3. The stronger Empiricist decision-procedure proposes to determine the truth of a geometry as follows. Let a physical interpretation: I be "spread over" the geometries:  $G_1, G_2, \dots, G_n$ . . . . generating an infinity of incompatible physical geometries:  $(G_1)I, (G_2)I, \dots, (G_n)I, \dots$ . A crucial experiment should select one physical geometry as true, and thus the corresponding geometry.

This procedure is rejected on the following grounds. The test of a physical geometry:  $(G_n)I$  tests a "system based on  $G_n$ ":  $((G_n)I \cdot P_n)$ ; where  $P_n$  represents ancillary physical statements necessarily entering into the test of  $(G_n)I$ . It is shown that any totality of available evidence which can be embedded in  $((G_n)I \cdot P_n)$  will be similarly embeddable in a "system based on" any other geometry of this totality:  $((G_m)I \cdot P'_n)$ .

This proves this set of geometries to be "S-conventional"; in accordance with which third specific Conventionalism in Geometry, there can be no experimental material embeddable in a "system based on" one geometry of this (S-conventional) set and not in a "system based on" any other geometry of the set.

Microfilm copy of complete manuscript of 261 pages, \$3.26. Enlargements 6" x 8", 10¢ per page.

#### THE DEVELOPMENT OF THE IDEA OF ESTRANGEMENT IN HEGEL'S EARLY WRITINGS

(Publication No. 3433)

Cornelius Richard Loew, Ph.D.  
Columbia University, 1951

One reason why Hegel's philosophy is regarded as irrelevant to our day is that his early theological writings never were published until 1907 and were not available in English until 1948. These fragments are crucial for understanding the whole of Hegel's thought because they express the central theological concerns which motivated his search for unity, concerns which later were symbolized by abstract terms that masked their continued presence and vitality.

The first half of the present study is an analysis of the two longest and most complete theological essays — "The Positivity of the Christian Religion" and "The Spirit of Christianity and its Fate" — in which the idea of estrangement is dealt with throughout and is carried through several stages of development. The second half begins with an examination of Hegel's first philosophical essays — "Differenz des Fichteschen und Schellingschen Systems" and "Glauben und Wissen" — and it concludes with an interpretation of the Phenomenology of Mind, his first major philosophical work, in which the meaning of the idea of estrangement becomes fixed and its role in the Hegelian system assured.

Chapter One introduces the idea of estrangement in a context of political absolutism and religious authoritarianism. Two motifs appear again and again: separation and externalization. These are the marks of estrangement. Through historical "parables" Hegel describes the forms of social and individual estrangement which develop when the organic unities of life are broken.

Chapter Two focusses attention on the estrangement introduced into knowledge by conceptualization. Hegel tries to discover a power of reconciliation within conscious thought which will reunite the elements of reality which the intellect "separates and externalizes." He discovers a dynamic function of estrangement in the Christian "process" of guild and forgiveness, in which not only is estrangement necessary but reconciliation is assured. He concludes that both estrangement and reconciliation are integral to all life processes, but he is unable to fashion a type of thought which can comprehend their process relationship.

Chapter Three announces Hegel's discovery that the intellect itself possesses a power capable of overcoming conceptual estrangement. He calls it Reason, and describes it in triadic dialectical terms. Estrangement is seen to be a creative, dynamic factor in all processes, and now the certainty of reconciliation is logically grounded. Estrangement is domesticated in the dialectic.

Chapter Four concentrates on estrangement as a necessary factor in the self-conscious development of

men and of societies. It culminates in the idea of a philosophical "strategy of estrangement," called recollection, whereby the philosopher is able to estrange himself from himself in the process of entering into, appreciating, appropriating, and conserving in sublimated form all previous states of existence throughout the entire span of history. The final threat to systematic reconciliation is found to be temporality, and reconciliation through recollection is presented as the answer to this threat. Thus all forms of estrangement are overcome by the philosopher.

The Conclusion suggests that Hegel subjects the idea of estrangement more and more to logical dialectical patterns and loses the concreteness of real life, in which estrangement is a matter of guilt and fate, of decision and destiny. Yet descriptively his idea of estrangement functions as a powerful root metaphor which sums up the folly, contradictions, incongruities, frustrations, anxieties, and self-destructiveness which pervade man's existence. Therefore, as a descriptive category estrangement deserves a place in any realistic and honest interpretation of the human situation.

Microfilm copy of complete manuscript of 149 pages, \$1.86. Enlargements 6" x 8", 10¢ per page.

#### SIR THOMAS BROWNE AND ARISTOTLE

(Publication No. 3074)

George Yost, Jr., Ph.D.  
Princeton University, 1941

Abstract not available.

Microfilm copy of complete manuscript of 343 pages, \$4.29. Enlargements 6" x 8", 10¢ per page.

#### PHYSICS

#### BURST PRODUCTION IN MATERIAL OF Z = 11 BY COSMIC RAYS AT SEA LEVEL

(Publication No. 3489)

Frank Edgar Driggers, Ph.D.  
University of Michigan, 1952

The purpose of this study is to obtain information concerning the high-energy interactions of  $\mu$ -mesons with matter by investigating the bursts produced in an ionization chamber by the cascade showers arising from these interactions. A large amount of ionization (a burst) may be produced in the chamber by several processes in addition to the  $\mu$ -meson interactions under investigation. It was thus necessary to eliminate or identify, to the extent that this is possible, these other types of bursts.

The ionization chamber used in this investigation was surrounded by a minimum thickness of four feet of commercial sand-lime brick and, in addition, was shielded by approximately four feet of concrete and

brick in the building in which the experiment was performed. The  $\mu$ -meson interactions occurred in the brick surrounding the chamber. The material in the brick pile and in the building attenuated the number of bursts arising from non- $\mu$ -meson interactions by attenuating the number of protons and charged  $\pi$  mesons (the primaries responsible for the bursts due to nuclear interactions) and by partially absorbing air showers.

The voltage pulses induced across the chamber electrodes by the collection of the ionization in a burst were amplified and photographed on a synchroscope screen. Air-shower bursts were identified by an auxiliary tray of Geiger tubes outside the absorber and bursts associated with nuclear events were, as far as possible; identified by the shape of the photographed pulse.

Calculations were made of the expected burst distribution arising from the electromagnetic interactions of spin-0 and spin-1/2  $\mu$  mesons. The interactions considered were the processes of bremsstrahlung, knock-on, and direct pair-production. In addition to these cross-sections, the calculations involved the differential energy spectrum of  $\mu$  mesons and certain aspects of cascade shower theory. All of these factors are considered in some detail.

The experimental results were about 40 per cent in excess of the predicted rate for spin 1/2  $\mu$  mesons and this excess was tentatively attributed to the cascade showers initiated by the decay of neutral  $\pi$  mesons arising from nuclear interactions in the brick pile. The results were not compatible with the assumption of spin-0 for the  $\mu$  meson. The expected Z dependence of  $\mu$ -meson bursts was roughly confirmed by a comparison with results obtained elsewhere under material of higher Z. It is indicated that the results obtained provide a quantitative validation for the bremsstrahlung and knock-on cross sections for  $\mu$  mesons in the energy range from  $10^{10}$  to  $10^{12}$  ev.

Microfilm copy of complete manuscript of 103 pages, \$1.29. Enlargements 6" x 8", 10¢ per page.

#### THE EFFECT OF NUCLEAR CHARGE AND BETA INTERFERENCE ON BETA-GAMMA ANGULAR CORRELATION

(Publication No. 3497)

Morton Fuchs, Ph.D.  
University of Michigan, 1952

Using relativistic wave functions for an electron in a coulomb field, the beta radiation patterns associated with the matrix elements of the five independent beta interaction Hamiltonians have been calculated in the approximation  $\alpha^2 z^2 \ll 1$  for the following cases:

1. The radiation patterns of the individual matrix elements in the first and second forbidden beta transitions.
2. The radiation patterns for the interference terms between matrix elements of the same degree (L) in the first and second forbidden.

3. The radiation patterns for the interference terms between elements of different degree in the first forbidden transitions.

In conjunction with the correlation tables of Falkoff and Uhlenbeck, the beta-gamma correlation is explicitly given and is suitable for the comparison of theory with experiment. The results obtained differ considerably from the previous  $Z=0$  calculations of Falkoff and Uhlenbeck.

In the absence of interference, it is found that a strong correspondence exists between the angular correlation and the spectrum energy correction factors of the beta matrix elements. Matrix elements with energy insensitive energy correction factors yield virtually zero angular correlation, and matrix elements with the most energy dependent energy correction factors have the largest angular correlation.

It is also found that the existence of interference easily destroys the above correspondence.

\*  $\alpha$  = Fine Structure Constant  
 $Z$  = Atomic Number

Microfilm copy of complete manuscript of 107 pages, \$1.34. Enlargements 6" x 8", 10¢ per page.

#### AN INVESTIGATION OF AUDITORY FATIGUE, WITH SPECIAL REFERENCE TO SUBJECTIVE HARMONICS

(Publication No. 3471)

Rudolph Henry Nichols, Jr., Ph.D.  
University of Michigan, 1939

Stimulation of the ear by a loud tone produces a temporary fatigue, or reduction of hearing acuity, following the stimulation. (1,2,3,4,5) In general, this diminution of acuity ("fatigue effect") appears to be greatest for tones of about the same frequency as that of the fatiguing tone. It was the purpose of the work reported in this thesis to investigate the pattern of fatigue effect vs. frequency in greater detail than had been done previously. In particular, it was desired to determine whether secondary maxima in the pattern occur at harmonics of the frequency of the fatiguing tone. If they did, they might provide a clue to the mode of generation of the "subjective harmonics" reported from other tests. (6) They might also provide a means of measuring the magnitude and relative phase of such subjective harmonics by a new and simple method.

A fatiguing tone of 202 cps 2 seconds long at a sound pressure level of about 90 decibels above .0002 dyne/cm<sup>2</sup> was used. It was followed directly by a short test tone whose level was adjusted until the observer could just hear it following the fatiguing tone. The cycle of the two tones was repeated by automatic switching at 11-second intervals, to give the observer repeated opportunities to adjust the test tone to threshold level. The difference, in decibels, between the observer's normal threshold for the test tone and his fatigued threshold for the test tone was taken as the amount of fatigue effect at the frequency of the test tone.

A number of measurements were made on ten observers. Extensive measurements were made on three of the ten. The results of the investigation are as follows:

1. The fatigue effect in db. at frequencies in the range 100-500 cps, due to the fatiguing tone of 202 cps, increases roughly linearly with the sound pressure level of the fatiguing tone in db. The rate of increase is about 10 db. in fatigue effect for 30 db. in fatiguing tone level.
2. Maximum fatigue effect appears to occur at a frequency a little higher than that of the fatiguing tone. The nature of the peak in the pattern of fatigue effect vs. frequency depends upon the observer: for some it is very low and broad, for one it was very high and sharp. The two ears of a given observer yield the same type of pattern.
3. Fatigue effect falls off very rapidly with decreasing frequency in the range below the frequency of the fatiguing tone. It falls off slowly with increasing frequency in the range above the frequency of the fatiguing tone (202 cps).
4. No significant evidence of secondary maxima at harmonics of the fatiguing tone was found in the pattern of fatigue effect vs. frequency.

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#### MEASUREMENT OF ISOTOPE RATIOS FOR CERTAIN GASES AND THEIR DISSOCIATION PRODUCTS

(Publication No. 3428)

Frank S. Stein, Ph.D.  
University of Buffalo, 1951

The general technique of measurement of stable isotope abundances by means of a dual-collector mass spectrometer is discussed in detail and information inferred from measurements of isotope ratios in nitrogen and carbon dioxide is presented.

The particular instrument used in this research is the Consolidated-Nier Isotope-Ratio Mass Spectrometer (Model 21-201). It is of the type designed by

Nier and is made commercially by the Consolidated Engineering Corporation. The errors incurred in its use originate in the electronic circuits, within the mass spectrometer envelope and in the flow of the sample gas from manifold to ionization chamber. For the usual tracer studies, in which an enriched compound is to be compared with a standard sample, most of these errors are not significant since they are partially annulled in the subtractive process of computing the enrichment. It is shown that under these circumstances only a correction for the residual peaks at the masses under consideration is indicated. Experimental verification of the constancy of the residual peaks, a condition necessary for successful application of the correction formula, is presented for the gas nitrogen.

For studies where the absolute rather than the relative isotope abundances are of interest, the measured value of the ratio may be made to approach the absolute value by the application of certain correctional procedures, both experimental and mathematical. A general equation is developed to correct for the errors. This is reduced to two simpler equations for the limiting cases of isotope ratios which approximate zero and unity respectively.

In addition to the errors which may be treated in a direct and simple manner, there are several errors which can be corrected only by taking a series of readings while varying the parameter in question. These include space charge effects, especially those, due to the electron ionizing current, and the accelerating voltage. It is shown how the isotope ratios in ions originating from  $\text{CO}_2$  vary with the latter parameters. Extrapolations to zero electron current and to infinite accelerating voltage are necessary to overcome these two errors. Also, the measured ratios depend on the sample pressure and on the time elapsing after sample introduction (the latter effect being particularly pronounced for samples of high enrichment), and it is advisable to take measurements on the flat portions of the curves if possible. For example, these portions occur around 50 mm Hg sample pressure and 30 minutes elapsed time, respectively, for one particular set of conditions.

A  $\text{CO}_2$  sample in which the  $\text{C}^{13}/\text{C}^{12}$  ratio was very nearly unity was prepared and purified. The ratios  $\pi_{\text{CO}} (\text{C}^{13}\text{O}^{16+}/\text{C}^{12}\text{O}^{16+})/(\text{C}^{13}\text{O}_2^{16+}/\text{C}^{12}\text{O}_2^{16+})$  and  $\pi_{\text{C}} (\text{C}^{13+}/\text{C}^{12+})/(\text{C}^{13}\text{O}_2^{16+}/\text{C}^{12}\text{O}_2^{16+})$  were measured and corrected for the errors discussed. The results are  $(.948 \pm .003)$  and  $(1.022 \pm .003)$ , respectively. These results are compared with those published in the literature and are not in general agreement.

A brief theoretical review of isotope effects in diatomic and polyatomic molecules is included. A recent theory which concludes from a consideration of normal modes that the ratio  $\pi_{\text{C}}$  for  $\text{CO}_2$  should be unity in the absence of instrumental errors is disputed and the arguments against the theory are presented. It is concluded that the actual isotope ratio in a molecule does not in general coincide with the ratio for

any of the ionization or dissociation products of the molecule.

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#### A STUDY ON ROTATION AND GRAVITATION

(Publication No. 3093)

Gerald E. Tauber, Ph.D.  
University of Minnesota, 1951

The work of this study can be divided into three separate, but logically connected parts:

a) A study of the gravitational field in free space due to rotating masses.

The most general line-element describing axial-symmetric stationary rotations was obtained, which resulted in the division of the gravitational field components into distinct groups ( $g_{AB} = P f_{AB}$ ,  $g_{A\dot{A}} = 0$  and  $g_{\dot{A}\dot{B}} \neq 0$ , where  $\dot{A} = 1, 2$  and  $\dot{A} = 3, 4$ ). With this symmetry restriction it was simple to obtain the curvature tensor. The number of field equations was reduced to an absolute minimum (four) consistent description of the four remaining field potentials, while the other two equations were reduced to boundary conditions. Several solutions to these equations under simple assumptions were obtained.

b) A covariant description of statistical mechanics for general relativity.

Due to the fact that Newton's equations of motion are equally good in general relativity (geodesic law) it was possible to obtain their canonical description by the introduction of an inertial function  $m$ , which is a constant of the motion on account of the geodesic equations. By the use of an invariant distribution function  $n$  Liouville's theorem was obtained in its relativistic invariant form. ( $dn/ds = 0$ ). It was then possible to construct an energy momentum tensor density, which satisfies the conservation laws identically. Application to spherical symmetric distributions resulted in relations between the density and pressure and thus constitute a critique of existing solutions. If this distribution function is subjected further to the requirements of thermal equilibrium, which is equivalent of taking account of the fluctuations of the gravitational field, the Maxwell Boltzmann and Fermi-Dirac distribution laws can be obtained. This, then, puts the results of relativistic thermodynamics, obtained by completely different methods, on a sure footing based on a self-consistent relativistic invariant statistical mechanics.

c) A description of rotating stars.

Applying the results of thermal equilibrium to rotating distributions of matter critiques of rotation in thermal equilibrium were obtained; in particular, this yielded a generalization of the rigid body rotation of a gas, besides the description of a proper temperature and angular velocity. In terms of the metric obtained earlier the problem of a rotating isothermal star (with and without circulation) has been set up. Finally it was possible to obtain a model of a

rotating Fermi gas at absolute zero, by imposing the restrictions of escape and complete degeneracy on the Fermi distribution.

All in all, the decisive steps necessary for a consistent solution are provided by this study and it is hoped that in the immediate future this work can be used to obtain concrete numerical results.

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**THE EFFECTS OF NUCLEAR SYMMETRY PROPERTIES ON NUCLEAR DIPOLE TRANSITIONS WITH SPECIAL APPLICATION TO A BOUND EXCITED STATE OF  ${}^2\text{He}^4$**

(Publication No. 3083)

Lynne E. H. Trainor, Ph.D.  
University of Minnesota, 1951

The effect of nuclear symmetry on electric dipole transitions in light nuclei has been investigated using the independent particle model and Wigner's theory of the symmetric hamiltonian. On this model nuclear wave functions are products or sums of products of individual particle wave functions which belong to irreducible representations of the symmetric group with respect to interchanges of the space coordinates of the particles, at least in the approximation that nuclear forces depend only upon space coordinates (ordinary and Majorana forces).

General methods are given for determining for a given nucleus, what multiplet states can occur and with what symmetry. The kinetic energy of a nuclear state is determined by the nucleon distribution over individual particle states and the potential energy is determined by the symmetry of the wave function. A procedure is outlined for obtaining the wave functions corresponding to a given symmetry and distribution over individual particle states, and having definite multiplicity, total angular momentum and z-component of total angular momentum.

From the form of the dipole operator applicable to nuclear transitions, a general symmetry selection rule is derived for all nuclei with equal proton and neutron numbers. A state with isotopic spin multiplicity  $\lambda$  may combine with a state of isotopic spin multiplicity  $\lambda \pm 2n$  where  $n$  is a positive odd integer, but it cannot combine with states for which  $n$  is zero or a positive even integer. The fact that additional symmetry selection rules operate is illustrated by examples.

Application of the selection rule for combining isotopic spin multiplicities is made to the  ${}^2\text{He}^4$  nucleus. The first excited state  ${}^1\text{P}_1$  (symmetric on all four particles) has zero transition dipole moment to the ground  ${}^1\text{S}_0$  state and one must attribute the strong 21.6 Mev dipole transition observed when protons are captured by tritium, to the  ${}^1\text{P}_1$  (symmetric on three particles) state. From the observed neutron threshold at 20 Mev it is concluded that the first excited state must be bound. The only alternative interpretation would require a very strong mixing of the two symmetry types.

To explain the angular distribution of gamma rays observed for two proton energies, spin-orbit and tensor forces are introduced as parameters and the  $\text{T}^3(\text{p}, \gamma) {}^4\text{He}^4$  reaction interpreted in terms of two Breit-Wigner resonances in the compound nucleus resulting from spin-orbit mixing of singlet and triplet spin states. Two solutions compatible with the experimental results are obtained. The spin-orbit and tensor forces are five times as great for the second solution but too little is known about these forces to choose between the solutions. The first solution seems preferable on the basis of reasonable splitting of otherwise degenerate levels. Also it predicts but a single bound excited state in contrast to three such for the second solution.

Symmetry selection rules do not appear to depend upon the explicit assumption of an independent particle model with its consequent limitations, but only on Wigner's theory and the premise that nuclear gamma radiation, to first order, involves only single particle transitions.

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**PHYSIOLOGY**

**STUDIES ON THE ANTRAL PHASE OF GASTRIC SECRETION**

(Publication No. 3204)

Donald John Ferguson, Ph.D.  
University of Minnesota, 1951

**Statement of the Problem**

The thesis is concerned with defining the precise origin of the second phase of gastric secretion, with the quantitative importance of this phase, and with its relation to vagal innervation of the stomach and to the secretion of pepsin.

**Review of Literature**

Early experiments by Beaumont, Heidenhain, Pavlov, and others, established the existence of the second, or gastric phase of gastric secretion (also called the antral or chemical phase). It is the secretory response of the stomach to stimuli acting within that organ. Edkins (1906) first proposed the idea that this phase is regulated by a hormone liberated from the antral mucosa. Although Edkins' experiments were inconclusive, the bulk of subsequent work, especially that of Komarov (1938) and Uvnas (1942), has substantiated his hypothesis.

Much clinical and experimental work has indicated the importance of the antral mucosa in surgical treatment of peptic ulcer.

The effect of vagotomy on the antral phase of gastric secretion was first studied by Orbeli (1906), who showed that this phase of secretion was decreased after the operation.

**Experiments on dogs with gastric pouches**

Fourteen dogs were studied. In eleven dogs there were from 2 to 4 separate gastric pouches.

Stimuli were applied to various parts of the stomach, and the secretion was measured from the other pouches. Eleven consecutive half-hour collections of gastric juice were measured and titrated for free acid, and in some cases for pepsin by the method of Anson and Mirsky. After the third specimen was obtained, stimuli were given. These included distention, flushing with meat extract, 7 per cent ethanol, pancreatic juice, and water. Comparison was made with the effects of injected histamine and pilocarpine in the same animals.

#### Experiments with mucosal extracts

Extracts of antral mucosa from dogs and from human stomachs obtained at operation were prepared by the method of Komarov. The active substance had the properties of a protein and was active only when given intravenously. It was assayed in anesthetized cats with isolated, vagotomized stomachs. It had no effect on blood pressure.

#### Conclusions

1. A series of 240 experiments in 11 dogs with multiple gastric pouches has shown that the gastric phase of gastric secretion depends almost entirely on stimulation of the antral mucosa.

2. The gastric secretory response to meat extract in the antrum in dogs is about half as much as that produced by 0.5 milligrams of histamine base injected subcutaneously.

3. In three dogs with multiple innervated gastric pouches, transthoracic vagotomy decreased the antral phase secretion by about 60 per cent. The response to histamine was decreased 68 per cent, and that to pilocarpine 58 per cent in the same animals. Vagotomy was shown to decrease not merely the basal secretion, but also the net response to stimuli, when the basal levels were subtracted from the responses. Unstimulated resting secretion was decreased 98 per cent, although the dogs were in better physical condition after vagotomy.

4. The secretion of pepsin, measured in multiple pouch dogs during continuous histamine stimulation, was possibly slightly increased by stimulation of the gastric mucosa, particularly the antrum. Cephalic phase stimuli, and pilocarpine, were much more effective under the same conditions. Pepsin output was decreased by over 50 per cent after vagotomy. The gastric humoral phase of pepsin secretion is probably of little importance.

5. Extracts of human and canine gastric mucosa, and other canine tissues, were assayed in 60 experiments on cats. The active substance, gastrin, was present almost exclusively in the antral mucosa.

6. Equal doses of the same extract were given before and after vagotomy, which decreased the response by 30 per cent.

7. Atropine had no effect, before or after vagotomy, on the response to injected antral extracts.

8. The injection of mucosal extracts intravenously apparently had little or no effect on pepsin secretion.

9. Antral mucosa obtained during the fasting state contains more gastrin than that from stomachs containing food.

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#### THE DEVELOPMENT OF METHODS OF ANGIOSTOMY CANNULATION OF AND TEMPERATURE MEASUREMENT IN THE PULMONARY ARTERY AND LEFT ATRIUM TOGETHER WITH A MEASURE OF RECTAL TEMPERATURES OF NORMAL DOGS

(Publication No. 3194)

George Wells Mather, Ph.D.  
University of Minnesota, 1951

Surgical procedure for the placement and utilization of angiostomy cannulae placed over the pulmonary artery and left atrium, the purpose of which was the direction of hypodermic needles into these sites, was developed. Several types of cannulae were used, the most satisfactory type consisting of three to six cm. lengths of silver tubing to which perforated 25 mm. thick silver plates were silver-soldered. These plates were shaped so as to facilitate their placement over the pulmonary artery or left auricle. These cannulae were fitted with stainless steel stilettos which prevented the formation of fibrin clots within them, and also prevented the cannulae from bending. The superficial ends of the cannulae were placed immediately beneath the skin in order to be readily accessible following recovery from surgery.

A highly satisfactory temperature measurement device was developed which allowed the continuous, simultaneous, and accurate evaluation of three body temperatures. This device consisted of hypodermic needle and rectal catheter-containing thermistor assemblies together with suitable resistance measurement equipment. Accuracy to 0.01° C. was obtained.

Experiments on dogs in which the two above procedures were employed revealed the following: a) The rectal temperature was higher than the blood temperature of the pulmonary artery and the left atrium under conditions of environments of 20° C. and -18° C. b) The pulmonary artery blood temperature was higher than that of the left atrium in environments of 20° C. and -18° C. This difference was in the order of 0.01° C. in an environment of 20° C. and 0.01° C. to 0.03° C. in environment of -18° C. c) The temperature difference between the pulmonary artery blood and the left atrial blood was greatest immediately after the animal was changed from the 20° C. environment to -18° C. environment. This greater difference durated for approximately 10 minutes after which the animal in some unknown manner appeared to compensate for the heat loss. d) There was an increase in the pulmonary artery blood temperature, the left atrial blood temperature, and the rectal temperature, when animals in an environment of 20° C. were suddenly exposed to an environment of -18° C. e) The cooling effect of the respiration of cold air upon the blood in the pulmonary circulation was small; the upper respiratory passages were very efficient in

warming cold air so that it did not influence the temperature of the pulmonary capillary network.

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#### REACTIONS OF BLOOD VESSELS IN LIVING NERVES

(Publication No. 3425)

Harold R. Murdock, Jr., Ph.D.  
University of Buffalo, 1951

A method is described by which the blood vessels of living nerves, the vasa nervorum, can be studied *in vivo*. Light is transmitted by a fused quartz rod from the light source to the nerve and the vasa nervorum studied by means of a microscope. The nerve is bathed with Ringer's or saline solution which is maintained at body temperature.

A detailed description is given of the normal pattern of the blood supply and the changes which take place after the nerve and its vessels have been exposed for several hours. These changes include the adherence of the leucocytes to the vessel walls, and the sludging of the erythrocytes.

Large sinusoidal vessels were discovered, predominately on the surface of the sciatic nerves of rabbits. They may serve as shunts to control the flow of blood in the pineural vessels.

Epinephrine, nor-epinephrine, 1-epinephrine, ephedrine, or pitressin, when applied locally on the surface of the nerve, constricted the arterioles and decreased the blood flow in the vasa nervorum. Intravenous injection of epinephrine increased the rate of flow even though the vessels constricted.

Histamine, amyl nitrite, nitroglycerine, nitranitol, magnesium sulfate, and priscoline, all dilated the vessels. When applied locally, histamine, nitranitol, magnesium sulfate, and priscoline increased the amount of blood flow, due to local dilatation. Amyl nitrite by inhalation, and nitroglycerine sublingually, decreased the flow because of general dilation and fall in blood pressure.

Cortisone decreased the adherence of the leucocytes to the vessel wall, and decreased the effects of epinephrine and nitranitol. The mechanism of this action is not known and only a few preliminary experiments have been performed.

It has been established that the somatic vasa nervorum do contract or dilate in response to sympathetic or other stimuli. This result adds one piece of observational evidence in support of the "vasospastic neuropathy" theory for explanation of cardiac referred pain as described by Roberts (1948) for it proves that vasospasm may occur in nerves.

An extensive review of the literature on the blood supply of nerves is included.

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#### OBSERVATIONS ON RESPIRATION USING A PNEUMOTACHOGRAPH

(Publication No. 3205)

Leonard F. Peltier, Ph.D.  
University of Minnesota, 1951

The theoretical basis for various methods of pneumotachography were reviewed. The clinical and experimental uses of pneumotachography were outlined. The construction and calibration of a photographically recording pneumotachograph of the mask type based upon an application of Poiseiulle's Law is described.

The respiration of five healthy subjects and four convalescent poliomyelitis patients was studied while subjecting them to varying amounts of negative pressure in a body respirator. An increase in the tidal volume was obtained in every case when the subject changed from nasal breathing to mouth breathing, and from mouth breathing to "yawn" breathing. The contour of the expiratory pneumotachograms shifted from the rectangular plateau form toward the spike form during this change in the attitude of breathing. This is indicative of the decrease in resistance to airflow accompanying the change in attitude. The relationship of the tidal volume to the negative intra respirator pressure was found to be an essentially linear one when the resistance to airflow was low. Individual variations were minimal due to standardization of the attitude of respiration.

During periods of hyperventilation in the body respirator, if the subjects dropped off to sleep audible strider ensued and accompanying this, a tremendous fall in the tidal volumes of the individual respiratory cycles. Periods of apnea occurred lasting as long as six cycles. This phenomena occurred in spite of the continuing action of the respirator and appeared to be due to a reflex closure of the glottis and collapse of the pharyngeal muscles.

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#### POLITICAL SCIENCE

#### JUDICIAL INTERPRETATION OF ANTI-INJUNCTION LEGISLATION IN THE FEDERAL AND NEW YORK COURTS

(Publication No. 2915)

Frank Howard Blumenthal, Ph.D.  
Princeton University, 1941

Abstract not available.

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**THE ORGANIZATION OF PERSONNEL  
ADMINISTRATION IN A SAMPLE  
OF FEDERAL AGENCIES**

(Publication No. 2943)

Milton Jacob Esman, Ph.D.  
Princeton University, 1942

Abstract not available.

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**THE POLITICAL THOUGHT OF JOHN BRIGHT**

(Publication No. 3527)

Charles Rush Layton, Ph.D.  
University of Michigan, 1952

What were the political principles of the English Victorian statesman, John Bright? To answer that question is the object of this dissertation.

His political utterances are studied both chronologically and topically to discover whether he consistently held the same views throughout or modified them with the change of times and circumstance. He is found to be not an original academic political philosopher; but the evidence is substantial that he possessed a well defined political thought which he, as Radical, Liberal, Quaker, applied in the consideration of nearly every important political problem of Victorian Britain.

The results reveal John Bright's opposition to the Corn Laws, Factory Laws, capital punishment, English wars, coercive retention of colonies such as Canada, India, Transvaal (his "little Englander" attitude even precluded retention of Suez and Gibraltar), participation in continental quarrels, aristocratic privilege, English treatment of Ireland, Irish Home Rule, and violence against law and order; and his support of nationalized universal education, the free institutions which he found exemplified in the United States, Indian reforms, Irish Church disestablishment and Land legislation, Parliamentary Reform, democratization of the suffrage, equal representation, supremacy of the Commons versus the Lords' veto, the British Constitution, and international arbitration versus war.

John Bright's political thought emerges thus: Man's political and economic life should be based upon three principles — freedom of action, laissez faire economic law, and Quaker moral law. The moral law is supreme but cannot operate apart from the principles of freedom of action and economic law. In government it is both expedient and moral to allow the individual man as large a measure of freedom and power as is consistent with a corresponding amount for others. This can be attained only through political democracy — representative government, popular franchise (by constitutional, not "natural right"), equal representation, sovereignty of the majority, secret ballot, and free public discussion and agitation. Both voters and representatives are to act

in harmony with economic and moral law. They are to open the way to many freedoms — of industry, religion, speech, press, educational opportunity, etc.; but they are not to stray into violations of laissez faire through collectivist legislation, nor are they in their quest for freedom to neglect the superior voice of conscience and moral righteousness. These same principles of freedom and morality in Bright's mind argue for anti-imperialism, colonial self-government or preparation for it. The laissez faire idea of non-interference in political economy links easily with that of non-intervention in foreign policy, retrenchment, and moralistic opposition to military aggression. This is a brief picture of John Bright's political thought — a peculiar blend of self-interest, Quaker morality, and free man philosophy for the whole people.

Some related conclusions are: he did his political work almost entirely through public speaking; his political thought came early out of his independent Quaker mind, and scarcely ever changed; he offered constructive solutions as well as destructive criticism; and his statesmanship was prophetic in that most of his principles and proposals were subsequently adopted by the British nation.

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**DUAL FEDERALISM IN CONSTITUTIONAL LAW**

(Publication No. 3039)

John Andrew Schroth, Ph.D.  
Princeton University, 1941

Abstract not available.

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**THE CHILEAN DEVELOPMENT CORPORATION**

(Publication No. 3431)

Kalman H. Silvert, Ph.D.  
University of Pennsylvania, 1948

La Corporación de Fomento de la Producción, Chile, was established by Law No. 6334, April 29, 1939, by a Popular Front government faced in its first year of life by a disastrous earthquake; the Corporation was designed to enable Chile to repay loans necessitated by earthquake reconstruction, as well as to raise the general standard of living and satisfy nationalistic sentiment by increasing domestic productivity. The Corporation, now acting under a slightly modified organic law (No. 6640, January 10, 1941), is an institutionalized portion of the Chilean social scene, seemingly acceptable to all major political parties. Its administration is "semi-fiscal" in nature; that is, its governing board is composed of persons nominated by private interest groups, such as trades unions and various owners' associations, as

well as certain branches of government, such as the houses of congress and the executive. The Corporation is not a direct dependency of any ministry, although constant liaison is mandatory.

As of March, 1948, the United States Export-Import Bank had extended \$ 65,000,000 in credits to the Corporation, private U.S. interests another \$ 5,000,000 in short-term credits, while \$ 16,000,000 was made available in that year by the Inter-national Bank for Reconstruction and Development. These loans are guaranteed by the Chilean government, repayment in dollars being made possible by tax levies on U.S. copper and nitrate corporations. The Development Corporation, fed by earmarked taxes, had by 1947 received some 1,760,000,000 pesos from the Chilean government, compared with slightly more than one billion pesos received in loans from the Export-Import Bank.

The Corporation has invested major sums in the following undertakings: a complex hydroelectric development program (ENDESA), a steel mill at Huachipato (La Compañía de Acero del Pacífico), petroleum explorations, a cement plant (Juan Soldado), refrigeration plants, mechanized agricultural equipment, copper fabrication (Madeco), RCA Victor-Chile, public transportation, irrigation and sugar beet projects, as well as small enterprises ranging from hemp to fishing equipment plants. In 1946, the Corporation held some 998,000,000 pesos of stock in 67 companies whose total capitalization equalled 2,300,000,000 pesos, although it had a controlling interest in few of the larger companies concerned, with the notable exception of ENDESA, the hydroelectric enterprise, in which it holds over 90 per cent of the shares.

The Development Corporation has been charged by law with formulating a general plan of economic development. The fact that the making of such an over-all plan has lagged may be a possible cause for dispersion of funds during the early years of the Corporation's existence, and may lead to social difficulties perhaps avoidable with sufficient study and foresight.

The government is engaging in capitalization because private persons have not the necessary economic resources. The drives toward economic self-sufficiency at a higher than present level and against foreign economic "domination" reinforce the intervention of government. A complicating factor is that Chile's small population can be supplied by large-scale plants well enough to militate against the possibilities of competition among a variety of producers, especially in such fields as steel, power, and oil, as well even as in some secondary industries such as tires and cement. The obvious political danger is that concentration of economic power without a sufficiently educated and alert public to control monopolistic government as well as private enterprise may lead to a weakening of the democratic process. Increased urbanization and consequent changing patterns of social organization may act as a brake upon the political results of the economic concentration which is a by-product of the Corporation's activities.

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THE POLITICAL RISE OF  
WILLIAM JENNINGS BRYAN FROM 1888  
TO THE NOMINATION FOR THE PRESIDENCY  
BY THE DEMOCRATIC PARTY IN 1896

(Publication No. 3455)

Robert Vincent Supple, Ph.D.  
New York University, 1951

The Problem and its Importance

This thesis discovered and analyzed the forces responsible for the political rise of William Jennings Bryan from 1888 to his nomination for the Presidency by the Democratic party in 1896. The specific factors studied provided tentative answers for Bryan's rise and gave a fuller understanding of the development of American political currents. The study was important because it offered insights into Bryan's progressivism, the methods employed by pressure groups, and dispelled a great political myth.

The thesis was divided into the following subproblems:

1. Bryan's services to the Democratic party, 1888-1890.
2. The circumstances under which Bryan first entered politics in his own behalf.
3. Bryan as a Congressman.
4. The reasons Bryan did not seek reelection in 1894.
5. Bryan's position on the significant political questions of the period.
6. The political activities of William Jennings Bryan, 1895-1896.
7. The role of the bosses in Bryan's career.

Historical Background of the Problem

William J. Bryan, a participant in the Democratic party from 1888 to 1896, was elected and reelected to Congress in 1890 and in 1892 from a Republican district in Nebraska. In 1894 he campaigned unsuccessfully for the United States' Senate and in 1896 became the standard-bearer for the Democratic party.

The political career of Bryan has received increased attention since his death in 1925. Previous studies did not explain the circumstances of Bryan's early rise. This study analyzed these forces and outlined the motives and principles basic to his development.

Procedure Used and Data Collected

Research trips were made to the areas in which Bryan was politically active and a research post was instituted at each location. The library facilities and the newspaper morgues at each site were explored for relevant data.

The basic data were derived from: 1) the Bryan Papers and writings of Bryan, 2) interviews with surviving contemporaries and members of the Bryan family, 3) issues of the Congressional Record, the Nebraska Bluebook and the Statistical Reports of Nebraska, 4) the text of the Bryan speeches and 5) standard history texts.

**Conclusions and Generalizations**

Bryan's rise contributed to the development of democracy and liberalism in the United States. The political functions of a democratic society were revealed through his political progressivism and his efforts in behalf of the common people. Bryan demonstrated that it was possible to gain political control by employing liberal trends for the benefit of the people.

The evidence substantiated the following generalizations:

1. Bryan was drafted by the Democratic party because of his ability as a speechmaker.
2. Bryan strengthened the Democratic party by providing it with a new understanding of liberalism and a new outlook in politics.
3. Bryan was the champion of the masses because of his fights against the powerful financial interests.
4. Bryan refused to stand for reelection so that he could develop the organization which would insure his nomination for the Presidency in 1896.
5. Bryan engaged in political tours from 1895 to 1896 through which he secured the pledges of state delegates.
6. Bryan worked his way to a position of leadership by refusing to make deals with the bosses.

**Suggested Applications and Recommendations**

Bryan's career may be employed as the vehicle to illustrate:

1. The techniques by which a leader comes to the fore.
2. How national issues and candidates are selected.
3. How undemocratic procedures may be corrected through public understanding and conscientious leadership.

Bryan's theory of political action minimized the old school of politics and demonstrated that political progress comes from the people. His ideals placed a realistic social value on leadership and his views on the honesty and value of politics were practical and elevating for they combined responsibility and creativity. The political rise of Bryan demonstrated that honesty and an adherence to principles were elements necessary to the development of progressive and popular leadership in our American political society.

Microfilm copy of complete manuscript of 373 pages, \$4.66. Enlargements 6" x 8", 10¢ per page.

**LAWYERS AGAINST GOVERNMENT  
THEIR ASSERTION AND DEFENSE OF LAISSEZ-FAIRE AS A CONSTITUTIONAL DOCTRINE**

(Publication No. 3057)

Benjamin R. Twiss, Ph.D.  
Princeton University, 1938

Abstract not available.

Microfilm copy of complete manuscript of 327 pages, \$4.09. Enlargements 6" x 8", 10¢ per page.

**PSYCHOLOGY**

**AN INVESTIGATION OF THE INTERRELATIONSHIPS OF SEVERAL MEASURES OF RIGIDITY UNDER VARYING CONDITIONS OF SECURITY**

(Publication No. 3462)

Dorothy Gordon Applezweig, Ph.D.  
University of Michigan, 1952

An extensive survey of the literature related to "stick-to-it-iveness" in human behavior revealed that many contradictory beliefs and hypothesis exist about the nature and measurement of persistence, perseveration and rigidity. It was the purpose of this investigation to determine the interrelationships of a number of so-called measures of rigidity, to discover what happens to these measures under varying conditions of security, and to attempt a more rigorous definition of rigidity.

The subjects were candidates for Submarine School at the New London, Connecticut, Naval Base. A battery of nine measures, including six so-called measures of rigidity, was administered to three equivalent groups of subjects the day before ( $N = 24$ ), the day after ( $N = 26$ ), and one week after ( $N = 29$ ) a real-life stress situation which was presumed to arouse feelings of insecurity.

Tau correlation coefficients computed for every test with every other test for each of the three groups revealed no evidence of a generalized rigidity. Furthermore, coefficients of concordance ( $W$ ) among the six measures of rigidity did not approach statistical significance under any of the experimental conditions.

A comparison of mean differences among the groups on the various measures of rigidity revealed that there were some statistically significant differences, although the direction of these differences was not consistent. An explanation of these results was offered, and evidence in support of this explanation presented.

A restricted definition of rigidity was proposed: any failure to change appropriately under conditions requiring change. Such failure may result from an inability, constitutional or psychogenic, to distinguish and/or utilize essential similarities and differences from situation to situation.

The following conclusions appear to be justified:

1. There is no general factor of rigidity (significant concordance) among a number of so-called measures of rigidity; the interrelationships of these measures appear to vary with the nature of the tests employed and the conditions of test administration, as well as behavioral determinants within the subject(s).

2. Scores obtained by an individual on any so-called measure of rigidity appear to be a function not only of the individual, but also of the nature of the test and the conditions of test administration.

Relations of the findings of this study to earlier investigations were discussed, and implications for further research indicated.

Microfilm copy of complete manuscript of 121 pages, \$1.51. Enlargements 6" x 8", 10¢ per page.

**A METHOD FOR DETERMINING THE DIMENSIONALITY OF A SET OF RANK-ORDERS**

(Publication No. 3469)

Joseph Ford Bennett, Ph.D.  
University of Michigan, 1951

**Introduction**

The origin of this problem lies in the overdependence of psychology on quantitative mensuration; it is advanced as a particular example of the possibilities of non-metric mathematics. The historical origins of the method in the "unfolding method" of Coombs and in multiple-factor analysis are traced.

**Description of the System**

The system is developed geometrically by the postulation of a space of dimension  $n$  in which are placed a set of "objects of judgement," represented by points, and "judges," also points. To each of the judges is assigned a rank-ordering of the objects of judgement according to their increasing distance from his own position. This leads to a partition of the space by loci of equidistance between pairs of objects of judgement, into cells within each of which all judges will make the same ordering of the objects of judgement. Much can be learned about the location of both judges and objects of judgement from an analysis of which of the "possible" cells of identical ordering (called isotonic regions) do and do not occur. The thesis concerns itself chiefly, however, with the criteria of dimension.

The first check on dimensionality derives from the fact that there is an upper limit on the number of regions which can all bound one another in a space of given dimension. In one-space, only two such regions may bound one another; in two-space, not more than four. It is unnecessary to pursue this method further, since in higher dimensions the following methods become simpler to use.

The second dimensional criterion derives from the limitation on the total possible number of isotonic regions which can be generated by a given number of objects of judgement in a space of given dimension. Computationally, the method involves counting the total number of different rank-orders experimentally obtained and comparing it with the entries in a table of maximum numbers, one of which is given in the thesis. The derivation of the table is based on the recursive Equation Two of the thesis:

$$C_{(n,k)} = C_{(n-1,k)} + (n-1)C_{(n-1,k-1)}$$

where  $C_{(n,k)}$  is the maximum number of isotonic regions created by  $n$  objects of judgement in a space of dimension  $k$ .

The third and most complete criterion of dimension is based on the observation that a space of dimension  $k$  contains all  $(k+1)!$  possible isotonic regions (i.e., rank-orders) of any set of  $k+1$  objects of judgement, no  $p$  of which lie in a  $p-2$  flat. On the other hand, a space of dimension  $k$  cannot contain the complete transposition-group of  $k+2$  or more objects of judgement. This final criterion is computationally the most difficult, but is also the most stringent of

the three, and provides the final criterion of dimension.

The special case in which all of the objects of judgement lie equidistant from some given point in the space, is considered. This case is of special interest because it requires that every judge's ordering be monotonic, and hence is the nearest analogue to multiple-factor analysis in non-metric form.

Microfilm copy of complete manuscript of 54 pages, \$1.00. Enlargements 6" x 8", 10¢ per page.

**SOME DETERMINANTS OF THE RELATIONSHIP BETWEEN RIGIDITY AND AUTHORITARIANISM**

(Publication No. 3475)

Roger William Brown, Ph.D.  
University of Michigan, 1952

In both general and psychological usage a negative value attaches to the term rigidity and this value appears to have mediated extension of the concept in explaining the origins of authoritarian attitudes. This extension derives empirical support from findings (like those of Rokeach) which relate rigid functioning on cognitive and perceptual problems to authoritarianism. Because exploratory studies failed to verify the Rokeach findings, a careful analysis was made of the experimental procedures involved. This analysis led to the suggestion that a correlation between problem-solving rigidity and authoritarianism occurs only if subjects experience some "anxiety over achievement" in the testing situation. It was specifically hypothesized that "achievement anxiety" would be aroused when the directions for the problems were ambiguous, provided the testing atmosphere was ego-involving. With the ambiguity of directions and the ego-involvement of the testing atmospheres as independent variables, a battery of tests was administered to several groups of high school and college students. The battery included the California F Scale (as a measure of authoritarianism), the Einstellung arithmetic problems (as a measure of cognitive rigidity) and the projective measure of the achievement motive (as an index of achievement anxiety).

The principal findings of these experiments were:

a) Two groups, both working in an ego-involving atmosphere, were given different directions for the Einstellung problems. The group receiving the more ambiguous directions showed a significantly higher correlation between F scores and Einstellung scores than did the group receiving less ambiguous directions.

b) Different testing atmospheres were induced in two groups — one was Ego-Involving, the other Non-Ego-Involving. The more ambiguous Einstellung directions were used for both groups. Under these circumstances there was a higher correlation between F scores and Einstellung scores for the Ego-Involved group than for the Non-Ego-Involved group. Within the Ego-Involved group, scores on the measure of the achievement motive were curvilinearly related to both Einstellung problem scores and F scores;

poorer Einstellung performances and more authoritarian F scores were associated with moderate scores on the achievement motive. Within the Non-Ego-Involved group, achievement motive scores and F scores were curvilinearly related as in the Ego-Involved group but Einstellung scores bore an essentially linear relationship to scores on the achievement motive. Better Einstellung scores were associated with higher scores on the measure of achievement motivation.

From all these findings in conjunction with those in the relevant literature, it is concluded that "anxiety over achievement" (as indicated by moderate scores on the need achievement measure) may be produced by the combination in child training of emphases on dependence and on competitive success. This "achievement anxiety," when situationally aroused, leads high F scorers to solve problems in a rigid manner. It is, finally, concluded that this interpretation is superior to other explanations of the relationship between authoritarianism and problem-solving rigidity in that it 1) provides a better "fit" for all the data and 2) eliminates the value judgments implicit in most other theories.

Microfilm copy of complete manuscript of 138 pages, \$1.73. Enlargements 6" x 8", 10¢ per page.

#### THE RELATIONSHIP OF VARIED TEST DEFINITIONS AND DEGREES OF EGO-INVOLVEMENT TO RORSCHACH TEST PERFORMANCE

(Publication No. 3476)

George Calden, Ph.D.  
University of Michigan, 1952

This study investigated the relationship of Rorschach Test responses to the subject's attitudes toward the testing. There were two main hypotheses; a) Rorschach protocols differ significantly as a function of varied test definitions, and b) test protocols differ significantly as a function of the subject's degree of ego-involvement in the task.

A sample population of 306 high school students was administered the Group Rorschach Test. The subjects were divided into two experimental groups. One was given an "ego-oriented" set of instructions which stated that the test results would be used to evaluate the individual subjects in job placement or in college counseling. The other group was given "task-oriented" instructions which explained the testing as part of a group research project sponsored by an out-of-state university. The instructions given to both groups also defined the test in three different ways. One third of the subjects was told the test measured "Intelligence"; another third was given the test definition of "Nervousness," and a final third was informed the test measured "Imagination."

Following the test administration the subjects answered a questionnaire designed to measure their ego-involvement in the test. They were then divided into 12 groups according to whether their instructions

were "ego-oriented" or "task-oriented," whether their ego-involvement was judged high or low, and their assigned test definitions.

The overall variance in scores among the 12 experimental groups was measured by the epsilon technique. Seventeen of the 25 conventional Rorschach scores and seven of the eight nonconventional percentage scores yield significant epsilons. However, one of the significant scores, R, the total number of responses, correlates above .50 with six of the other significant scores; D, O, H+Hd, A+Ad, W% and D%.

The relationship of test protocols to degrees of ego-involvement was measured by t-test comparisons of scores of the high and low involved subjects given "task-oriented" instructions. In comparison with scores obtained by the low ego-involved group, the high involved subjects produce significantly more R, D, M, m, Sum C, Y+V, T, Blends, H+Hd, A+Ad, O, VIII-X%, m%, Sum C% and less F% and A+Ad%.

The relationship of test protocols to the varied test definitions was measured by t-test comparisons of scores of the groups assigned the three test definition instructions. The subjects assigned the Imagination instructions produce significantly more M, m, H+Hd, m%, Sum C%, and less F% and A+Ad% than subjects assigned the Intelligence test definition. The Imagination group also produces significantly more m, Y+V, O, m%, O% and less A+Ad% than the Nervousness group. Differences in scores between Nervousness and Intelligence groups are attributed to chance factors.

An additional analysis dealing with the interaction of ego-involvement and test definition variables yields inconclusive results.

The following scores are not significantly affected by the experimental variables; W, S, F+, F-, P, FM, F+% and H%.

In summary: the two major hypotheses pertaining to the relationship of Rorschach scores to varied test definitions and degrees of ego-involvement are found to be tenable beyond chance expectancy. Approximately three to ten per cent of the total variance among significant scores is associated with the experimental variables.

The implications of these findings for Rorschach theory and practice are presented. Suggestions are made for further investigation in areas related to this study.

Microfilm copy of complete manuscript of 172 pages, \$2.15. Enlargements 6" x 8", 10¢ per page.

#### TWO LEVELS OF UNCONSCIOUS AWARENESS

(Publication No. 3479)

Chester Dillingham Clapp, Ph.D.  
University of Michigan, 1952

This research was directed toward the investigation of phenomena subsumed under the heading of perceptual discrimination without awareness. The following hypothesis, suggested partly by experiments in the area of "perceptual defense" and partly by the

psychoanalytic formulation of levels of awareness, was set up: When "more" and "less" emotional stimuli are presented in pairs at two levels of unconscious awareness, there will be a relative shift in the judgment of perceptual clarity, from more emotional stimulus seen as clearer at the lower level toward less emotional stimulus seen as clearer at the higher.

The pairs of "more" and "less" emotional stimuli were selected from the Blacky Pictures, a modified projective technique based on psychoanalytic theory. On the basis of criteria relating to physical quality and degree of emotionality, three pairs of pictures were chosen: two (Pairs 1 and 3) consisting of a more and a less emotional picture, and a control pair (Pair 2) with two less emotional pictures. No shift was expected in the latter pair because of the lack of contrasting emotionality. The two levels of unconscious awareness were manipulated by tachistoscopic presentation of the pairs at fast and slow shutter speeds. The subjects (volunteer college students of both sexes) were only required to judge which picture within a given pair seemed the "clearer" (i. e., closer to looking like something).

The experimental subjects ( $N = 82$ ) were given the group Blacky Pictures test prior to the tachistoscopic trials in order to "saturate" them with the emotional qualities of the pictures. The results showed that they behaved in accord with the hypothesis. Statistically significant shifts from relative clarity preference for the more emotional stimulus at the fast speeds to clarity preference for the less emotional stimulus at the slow occurred on Pairs 1 and 3. As predicted, Pair 2 did not show a shift.

Behavior of subjects ( $N = 64$ ) in the appropriate control condition supported the interpretations made from the experimental data on Pairs 1 and 2, since shifts did not occur on the former and did occur on the latter. The controls shifted in the same direction as the experimental subjects on Pair 3, which did not support the hypothesis. More detailed analysis of this pair suggested the necessity for further research before definitive conclusions could be drawn from it.

The generally positive findings of the study affirm those parts of psychoanalytic theory which served as a framework for the design and its predictions. The notion of "unconscious behavior" was borne out by the experimental subjects, who were able to discriminate between degrees of emotionality at two levels of awareness below consciousness. The subjects were more responsive to the highly emotional material at levels farther from direct awareness, and less responsive to it at levels closer to direct awareness. These facts were interpreted as specific support for the psychoanalytic concepts of ego defense and repressed strivings. In addition to theoretical issues, an evaluation of associated methodological problems was made, with emphasis on the suggested extensions of the present study and implications for the field of perception.

Microfilm copy of complete manuscript of 59 pages, \$1.00. Enlargements 6" x 8", 10¢ per page.

### THE INFLUENCE OF TWO ATTITUDINAL VARIABLES ON GROUP RORSCHACH TEST PERFORMANCE

(Publication No. 3481)

Leon Bernard Cohen, Ph. D.  
University of Michigan, 1952

This study investigated the relationship of group Rorschach responses to two attitudinal variables, test definition and ego-involvement. There were three major hypotheses: Rorschach scores differ significantly as a function of 1) different test definitions, 2) different ego-involvement instructions, and 3) the simultaneous operation of the two attitudinal variables.

The group Rorschach test was administered to 306 senior high school students who were randomly divided into two experimental groups. One group received "ego-orientation" instructions which emphasized personal evaluation of the subject. Anonymity was stressed in the "task-orientation" instructions given to the other group. An approximately equal number of subjects in each group was assigned one of three test definitions: "Intelligence," "Nervousness," "Imagination." Following the administration of the test, all subjects answered a questionnaire designed to measure their ego-involvement in the task.

An analysis of the overall variances of Rorschach scores among the experimental groups reveals that 17 of the 25 conventional scores and seven of the eight non-conventional percentage scores are significant. Approximately three to 10 per cent of the variance in the significant scores is attributable to the experimental variables.

The hypothesis pertaining to the relationship of test definitions to Rorschach scores was found to be tenable. The subjects assigned the test definition of intelligence tend to engage in significantly less phantasy and "inner living" ( $M, M\%$ ,  $m, m\%$ ) than the nervousness and imagination subjects. The imagination group shows significantly less stereotypy ( $A\%$ ) and more originality ( $O, O\%$ ) in thinking than the intelligence and nervousness groups. The nervousness group produces significantly less texture ( $T$ ) responses than the intelligence and imagination groups.

The hypothesis concerning the relationship of ego-involvement instructions to Rorschach scores was also found to be tenable. The "task-oriented" highly involved subjects produce a significantly higher percentage of form responses ( $F\%$ ) than the "ego-oriented" group. The protocols of the ego-oriented subjects, on the other hand, tend to reflect significantly more anxiety ( $T, T\%, C, C\%$ ), an increased sensitivity to external stimulation ( $\text{Sum } C$ ), a greater capacity for phantasy ( $M$ ), and a larger production of rich ( $\text{Blends}, \text{Blends}\%$ ) and original ( $O$ ) associations.

The data do not provide enough evidence to support fully the hypothesis that the simultaneous operation of the two experimental variables is significantly related to test performance. Only six of the 10 obtained significant differences are found to be independent of  $R$ . Since five independent differences might

occur by chance, the results barely exceed chance expectancy. The majority of the differences occur when the ego-involvement instructions interact with the intelligence and nervousness test definition. The ego-involvement instructions have the least influence on the imagination test definition.

The implications of these findings for Rorschach interpretation and administration, as well as for theory and practice underlying testing procedures in general are presented.

Microfilm copy of complete manuscript of 205 pages, \$2.56. Enlargements 6" x 8", 10¢ per page.

#### THE MEASUREMENT OF SUBJECTS' ORIENTATIONS TOWARD A SENTENCE COMPLETION TEST

(Publication No. 3482)

Haskell Robert Coplin, Ph.D.  
University of Michigan, 1952

This study deals with the degree to which subjects modify their responses to a projective test in order to present themselves in a more favorable light, and the relationship of such behavior to aspects of personality. The study involved the development of eleven measures of various verbal orientations used by individuals in completing semi-structured sentence leads and a study of the relationships of scores on these measures to personality ratings, self-ratings, and objective test scores. Semi-objectively scored measures were developed for evasive and self-enhancing sets as well as for sets to be perceived as objective, altruistic, positive or negative toward others, as wanting to achieve, desiring independence, and as being affiliative. Estimates of test and scoring reliability were computed for all measures and found to be of acceptable magnitude. A factor analysis of the intercorrelations of subtests yielded three factors indicating general sets which were identified as "Fairmindedness," "Frankness," and "Status Drive."

The population used in this study consisted of 111 male college graduates who were subjects of intensive pre-training assessment by the VA sponsored Research Project on the Selection of Clinical Psychologists. Sentence Completion records of two matched halves of this population were scored independently by two judges for the response set variables and correlations computed for the two groups between response set scores and criterion measures. A test of the validities of ratings based on Sentence Completion subtest scores alone and in combination with the test protocol was made.

The findings are summarized as follows:

1. Of the 1320 correlations resulting from the correlation of the 11 subtest scores with 60 criterion measures for the two groups, 267 or approximately 20% were significant at the 10% level. There are 20 pairs of correlations which were significant at the 10% level in both samples and hence significant at the 1% level.

2. In spite of acceptable interscorer reliability, the pattern of relationships of some variables to criterion measures differed for the two groups scored by the different judges.

3. Ratings of half the subjects on 42 personality rating scale variables using only the Sentence Completion Subtest profile scores as the basis for the ratings, in general, showed lower validities than ratings based on the Sentence Completion subtest profile plus the content of the Sentence Completion tests.

It was concluded that the verbal behavior of an individual in a relatively unstructured test situation may be classified into a number of expressive modes which can be reliably measured. These modes are significantly related to a number of personality attributes. A profile of scores of subtests measuring these verbal orientations provides a basis for valid ratings of some personality attributes. However, a combination of these scores and the content of the Sentence Completion record permits more valid personality ratings for a larger number of variables.

Interpretation of responses to some verbal projective techniques may be influenced by the set of the interpreter even when the scoring is semi-objective.

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#### THE CLINICIAN'S PERSONALITY AND HIS CASE REPORTS

(Publication No. 3494)

Richard Nelson Filer, Ph.D.  
University of Michigan, 1952

This is a study of the relationship of the clinical psychologist's personality to his written reports. The reports represent the clinician's interpretations of a patient's behavior in a psychological testing situation. Two major problem areas are investigated: 1) whether different examiners emphasize different personality dimensions in their case reports and 2) whether such differences are significantly related to measures of the examiner's personality characteristics.

From the reports of thirteen male clinicians at the Detroit Mental Hygiene Clinic tabulations were made of references to the following dimensions:

1. Hostility
2. Hostility turned inward
3. Passive-dependency
4. Feelings of insecurity

The frequency of references to these four dimensions was assumed to be in part an expression of the clinician's own needs and defenses. Certain relationships were hypothesized between the frequencies with which examiners refer to these dimensions and independent ratings of the examiner's behavior in terms of acendency, depression, and intropunitiveness, extrapunitiveness and impunitiveness.

All dimensions were dichotomized and the resultant data arranged into 2 x 2 contingency tables. Fisher's exact method was used to determine the

chance probability of each table. All analyses were significant at the 5% level or less. Among the findings are the following:

1. Examiners who stress hostility turned inward tend to be rated depressed and intropunitive.
2. Examiners who stress hostility turned inward and either passive-dependency or insecurity tend to be rated submissive.
3. Stress on either insecurity or passive-dependency but not on hostility turned inward is significantly associated with behavioral ratings which place the examiner in the upper half of the distribution of ascendency.
4. Of those classified most ascendent, examiners who are above the median on references to hostility in their reports are rated also as extrapunitive.

In a separate study of reference to defense mechanisms, predictions were made about the examiners as a group. An exploratory count revealed that conscious controls, compulsive defenses, and intellectualization were the three most frequently mentioned defense mechanisms. These three were included in a list of thirteen defense mechanisms and subsequently ranked by judges in order of the relative emphasis placed upon them by patients and examiners. The consensus of the raters is that conscious controls, compulsive defenses, and intellectualization are characteristically emphasized more in the behavior of the examiners than in that of the patient group. The three most frequently mentioned defenses are thus more characteristic of the clinicians than of their patients. However, of the next six most frequent defenses in the reports, five are the same as the first five listed by the judges for the patients.

In view of the findings it is concluded that there is a significant relationship between the examiner's personality and his case reports. Among the implications of these findings are 1) the clinician has to consider his own needs when interpreting the behavior of others and 2) research is needed on the determinants of test protocols and on simpler, more objective projective tests.

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#### THE EFFECT OF DIFFERENT DIMENSIONS OF DISAGREEMENT ON THE COMMUNICATION PROCESS IN SMALL GROUPS

(Publication No. 3500)

Harold Benjamin Gerard, Ph.D.  
University of Michigan, 1952

This thesis reports an experimental study of some aspects of the influence process in small groups.

Findings in some previous experiments indicated that:

1. The greater the pressures toward uniformity in a group, the greater will be the amount of communication (the means by which influence is exerted) between those members whose opinions are discrepant from each other.

2. The greater the pressures toward uniformity, the greater will be the amount of change toward the group standard.

3. The greater the opportunity for subgroup formation, i. e., for changing the composition of the psychological group, the greater will be the tendency of members to reject deviates and hence cease communicating to them.

The above findings concern a group where one dimension of disagreement exists. The present writer attempted to determine whether or not these findings would generalize to a situation where more than one dimension of disagreement exists.

The subjects used in the experiment were university students who assembled in groups ranging in size from eight to 14 members. They discussed, by means of written messages, a problem which created two dimensions of disagreement. One dimension divided the group into two unequal subgroups (a majority and a minority). This division concerned the choice of which one of two issues in the problem was more important. Further disagreement was possible concerning opinions on the two issues.

Two degrees of pressures toward uniformity (high and low) were manipulated by verbal induction. Two degrees of perception of the group composition were similarly manipulated along a dimension of homogeneity-heterogeneity with respect to the perception of the background and experience of others in the group. These manipulations resulted in four experimental conditions: Homogeneity-high pressure (Hom-hi), Homogeneity-low pressure (Hom-lo), Heterogeneity-high pressure (Het-hi), and Heterogeneity-low pressure (Het-lo).

The results indicated the following conclusions:

1. The division of the groups into a majority and a minority had a crucial effect on the relative need for support by the members of these subgroups. The minority members needed more support from others in the total group and from others in their own subgroup than did those in the majority. This was indicated by the following data:

a. In all conditions, there was a greater amount of influence concerning the disagreement which divided the group in two by those in the minority than by those in the majority.

b. There was a greater amount of opinion influence (the other dimension of disagreement) per possible recipient within the minority than within the majority.

c. Minority members changed their choice of issue more often than did majority members.

2. Pressures toward uniformity arose in the homogeneous conditions. These pressures were greater in the Hom-hi than in the Hom-lo groups. This was indicated by the following data:

a. There was a greater amount of communication attempting to achieve uniformity of the group as a whole (influence concerning the relative importance of the two issues) in the homogeneous than in the heterogeneous groups. The amount of this communication tended to be greater in the Hom-hi than in the Hom-lo condition.

b. A greater amount of opinion influence on the important issue relative to the amount on the

less important issue occurred in the homogeneous minorities. The proportion tended to be greater for the Hom-hi than for the Hom-lo minority.

c. Change toward uniformity occurred only in the Hom-hi condition, the minority members changing most in the direction of the group.

3. Pressures to agree with experts arose in the heterogeneous groups. These pressures tended to be greater in the Het-hi than in the Het-lo condition. This was indicated by the following data:

a. No change toward uniformity occurred in the heterogeneous conditions.

b. Deviates as well as agrees changed in response to opinion influence. The amount of this change in response to influence from experts was greater in the Het-hi than in the Het-lo groups.

4. The tendency toward group subdivision was greater in the heterogeneous than in the homogeneous conditions. This was indicated by the following data:

a. There was less communication attempting to achieve uniformity of the group as a whole (issue influence) initiated by subjects in the heterogeneous minorities than by those in the homogeneous minorities.

b. At the outset there was less communication to deviates within the heterogeneous than within the homogeneous majority.

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#### A PROJECTIVE STUDY OF PSYCHOANALYTIC MECHANISMS OF DEFENSE

(Publication No. 3501)

Stanley Goldstein, Ph.D.  
University of Michigan, 1952

According to psychoanalytic theory, the ego is that part of the personality whose function it is to mediate between internal demands of the organism and external demands of the environment. Unacceptable impulses from within are said to be handled by means of "mechanisms of defense." This study was undertaken to explore the preferences of normal subjects for selected mechanisms: repression (removal of the impulse from conscious awareness); regression (reversion to behavior characteristic of an earlier genetic stage); reaction formation (development of conscious attitudes opposite to the underlying impulse); and projection (attribution of the impulse to others rather than the self).

The following topics were investigated: 1) The empirical question, "Do normal subjects have consistent, stable defense preferences?" 2) The theoretical deduction that consistency of preference is positively associated with degree of conflict aroused by the impulse. 3) The theoretical prediction that reaction formation is an extension of repression.

Groups of subjects (the total of 104 consisting of forty-one men and sixty-three women), recruited from introductory social science courses, were

administered an adaptation of the Blacky Pictures. The latter technique, designed to tap major psychoanalytic dimensions of personality, was modified to include the following components: spontaneous stories to eight of the original eleven cartoons; and a defense preference inquiry (DPI) developed by the author and checked for apparent validity by three qualified clinical psychologists. The DPI consisted of a set of statements for each cartoon corresponding to the four defense mechanisms. These were ranked by the subjects, after they finished each story, on the basis of how well the statements agreed with their spontaneous interpretation of the cartoon. One month after the first administrations, thirty-eight subjects were retested.

The following results were obtained: 1) The groups as a whole did not exhibit consistent defense preferences, although a significantly large minority did. The choices of both inconsistent and consistent subjects proved to be stable in the retest. 2) Greater consistency of preference in more conflicted areas was not confirmed. 3) The predicted relationship between reaction formation and repression was confirmed and also found to be reciprocal. A similar reciprocal effect was noted for regression and projection.

These data support the postulation of two stable types of defenders within this normal group: a large sub-group of specific defenders who prefer different defenses for different impulses; and a small group of general defenders who tend to employ the same defenses for all impulses. Since theory points to stereotypy of defense as characteristic of emotional disorders, the stories of the two sub-groups were analyzed for incidence of strong conflict. This evidence did suggest the general defenders to be more emotionally disturbed. The obtained dichotomy among the four defenses was interpreted as support for theory concerning basic properties of these mechanisms.

The above findings, along with the negative results relating to consistency vs. degree of conflict, were then discussed in terms of their application to normal and pathological groups. Directions of future research were also indicated.

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#### THE EFFECT OF MULTIPLE VITAMIN THERAPY ON INTELLIGENCE, SCHOOL ACHIEVEMENT, LEARNING ABILITY, MOTOR SPEED AND VISUAL MOTOR COORDINATION OF SCHOOL CHILDREN

(Publication No. 3447)

Frances Gaezer Grossman, Ph. D.  
New York University, 1951

Nutritional studies throughout the nation have revealed that malnutrition is widespread among the population of this country. Large segments of the world's population exist in a chronic state of under-nutrition of varying degrees. The history of recent years has increased considerably, the number of people involved, and has made the study of human nutrition one of great importance.

While severe nutritional deficiency as encountered in pellagrins, among war prisoners and inmates of concentration camps, has been known to produce marked changes in mental function, including deterioration and even psychoses, little evidence is available concerning the milder, chronic forms of malnutrition found among the so called normal population, and its effects on intellectual activity.

The results of studies in which vitamin therapy has been used, have been inconclusive. Furthermore, most investigations have concerned themselves with the addition of a single vitamin, or food substance to the diet. Since there is evidence to the effect that vitamins, particularly those of the B Complex, occur together in their natural state, and that vitamin deficiencies are usually multiple in nature, further study in order to evaluate the effect of multiple vitamin supplementation, seemed indicated.

This investigation extended from the Spring of 1948 through the Spring of 1949. The study was conducted at a Nutrition Clinic, located on the Lower East Side, Manhattan, New York.

The subjects studied consisted of 75 white, American born school children, from seven through eleven years of age, of average intelligence, who were clinically diagnosed by the medical staff of the Clinic, as suffering from malnutrition. The children were divided into two groups, 36 in the control group and 39 in the experimental group. A battery of psychological tests was administered to each child at the beginning of the experimental period. These included tests of intelligence, school achievement, learning ability and psychomotor performance. At the end of a year of vitamin therapy, each child was retested.

Therapy consisted of Squibb's Basic Formula, which contains thiamin, riboflavin, niacin and ascorbic acid. This was given in capsule form to the experimental group with instructions for one capsule to be taken daily. The control group was given placebos with similar instructions. In addition, both groups were given White's Cod Liver Oil Tablets, which contain Vitamins A and D, since it was believed by the medical staff that growing children should not be deprived of the latter supplementation, even for purposes of investigation. Therapy was supervised by a Nutritionist-Social Worker, who saw the children and parents regularly at two week intervals and made home visits when necessary.

Although both groups initially scored within the average range of ability, the control group was somewhat superior to the experimental group on all tests. Upon retesting, the experimental group scored greater gains than the control group on all but two of the eleven tests which were given. While only the gain on the vocabulary test attained the .05 level of statistical significance for the experimental group, it is believed that the general direction of consistently greater gain for the experimental group, is important.

When the gains were compared with those which would normally be expected from a group of children of average intelligence, it was found that the experimental group in some cases exceeded normal expectancy, whereas, this was not true of the control group.

In almost all cases, the greatest gains were achieved on those tests where initially the mean scores had been lowest.

It was concluded therefore, that positive changes did occur in the direction of enabling the undernourished child receiving vitamin supplementation to function closer to his or her maximal intellectual capacity. However, not all children benefitted equally from this type of treatment. Individual differences were found to exist in response to vitamin therapy. These factors should be further studied.

Microfilm copy of complete manuscript of 218 pages, \$2.73. Enlargements 6" x 8", 10¢ per page.

#### ON THE RELATIONSHIP BETWEEN ANXIETY AND NIGHT VISION

(Publication No. 2749)

Earl Joseph Janda, Ph.D.  
University of Michigan, 1952

An extensive review of the psychological literature bearing on the general problem of relationships between personality and perceptual variables and on the specific problem of the relationship between anxiety and night vision was undertaken. The purpose of the two studies reported was to determine whether or not night vision response thresholds, obtained by the Voluntary Report method using the Feldman Adapto-meter, are affected by anxiety or stress. The night vision performance of high stress (neurotic) and low stress (normal) subjects were compared. Subjects were further classified according to their usual mode of handling stress: expressor subjects who frequently show manifest anxiety and repressor subjects who seek by various devices (ego defenses) to thwart the direct expression of manifest anxiety. Psychiatric evaluations and the Minnesota Multiphasic Personality Inventory were employed in the selection and classification of subjects.

In the first study "rigid peripheral fixation instructions" were used; the subject was asked to continuously fixate in such a manner that indirect vision approximately fourteen degrees off the fovea, would be used. The subject's task was to report the position (vertical, horizontal or diagonal) of the faintly illuminated oblong stimulus. In the second study "flexible peripheral fixation instructions" were given; the subject was encouraged to use peripheral vision and given the freedom to fixate in his own way. Each subject had the task of reporting "stimulus position" and later, during the same trial, the task of recognizing and naming the silhouette of a familiar object. In both studies the night vision test was repeated for each subject, the second trial about fifteen minutes after the first.

The results of these two studies suggest the following general conclusions:

1. Night vision response thresholds obtained by the Voluntary Report method, are related to:
  - a. the subject's chronic level of stress.

- b. the subject's usual mode of handling stress.
  - c. the subject's past experience in the night vision test situation.
  - d. the manner in which the subject follows fixation instructions.
2. High stress (neurotic) subjects when compared to low stress (normal) subjects are likely to show impaired voluntary report thresholds when these subjects:
- a. have had no previous experience in the night vision test situation.
  - b. are given a task for which the use of extreme peripheral vision is advantageous.
  - c. are given "flexible fixation instructions."
3. Differential shifts in performance upon retest, which underlie the rather low test-retest reliability of night vision response thresholds obtained by the Voluntary Report method, are related to:
- a. the subject's level of stress.
  - b. the subject's usual mode of handling stress.
4. In general, subjects using the expressor mode of handling stress show a large relative improvement in voluntary report time while subjects using the repressor mode show a small relative improvement.
5. Whether the complexity of the stimulus material assists in differentiating the performance of high stress (neurotic) and low stress (normal) subjects in a night vision test situation is a function of other aspects of the testing situation.
6. The profile scores of the Minnesota Multiphasic Personality Inventory permit the selection of groups of subjects who differ in their perceptual efficiency in a night vision situation.

Microfilm copy of complete manuscript of 143 pages, \$1.79. Enlargements 6" x 8", 10¢ per page.

#### A THEORETICAL AND EXPERIMENTAL INVESTIGATION OF ABSOLUTE AND RELATIONAL STIMULUS TRAINING IN DISCRIMINATION LEARNING

(Publication No. 3523)

Sheldon Joseph Lachman, Sc. D.  
University of Michigan, 1952

#### Problem

To obtain evidence regarding the adequacy of training in discrimination problems under relational conditions in which both the negative and positive stimuli are simultaneously present and under absolute conditions in which only one stimulus, either the negative or the positive, is displayed (but not both simultaneously). Gestalt theorists propose that discrimination is a relational process. Many behavior theorists, such as Spence, hold that discrimination is essentially a function of the number of reinforcements and nonreinforcements following reactions to each stimulus, i. e., that discrimination is a matter of developing positive response tendencies (habit strength) and negative response tendencies (inhibitory strength) to each stimulus, and discrimination is reducible to

differential training with each individual stimulus component separately in an absolute fashion.

#### Subjects Used

Four groups of female rats were used.

Group I. (N: 8) These animals were given relational training with the brighter stimulus window as positive.

Group II. (N: 10) These animals were given absolute training with the brighter stimulus window as positive.

Group III. (N: 12) These animals were given relational training with the dimmer stimulus window as positive.

Group IV. (N: 12) These animals were given absolute training with the dimmer stimulus window as positive.

#### Procedure

Subjects in group I were trained until they reached the criterion of four successive days without error (ten trials per day). Subjects in group II were trained by the absolute method and given as many (or more) trials to each stimulus as were required by the poorest subject in group I to attain the criterion. Then group II subjects were tested with both stimuli present. Subjects in group III were trained until they reached the criterion of four successive days without error (ten trials per day). Subjects in group IV were trained by the absolute method and given as many (or more) trials to each stimulus as were required by the poorest subject in group III to attain the criterion. Then group IV subjects were tested with both stimuli present.

#### Results

All subjects in the relational groups, groups I and III, reached the learning criterion. Subjects in group II on being tested exhibited a strong preference to go to the brighter of the two lights. Subjects in group IV on being tested also exhibited a strong tendency to go to the brighter of the two lights despite the fact that these subjects (group IV) had been trained to go to the dimmer stimulus. None of these animals (group IV) even remotely approached the learning criterion. Hence, regardless of whether animals were trained by the absolute method to go to the brighter or to the dimmer stimulus, when both stimuli were presented simultaneously, all preferred the brighter. These results are interpreted to support the gestalt concept, i. e., that discrimination is based upon the "comparative" (or relational) aspects of the immediate component stimuli of the configuration, and that training upon the component stimuli separately is inadequate, at least less adequate, in producing efficacious discriminatory reactions.

Microfilm copy of complete manuscript of 90 pages, \$1.13. Enlargements 6" x 8", 10¢ per page.

A STUDY OF THE VALIDITY OF INDIVIDUAL PERSONALITY PROFILES BASED ON EACH OF FOUR PROJECTIVE TECHNIQUES

(Publication No. 3530)

Edward Vartan Malcom, Ph.D.  
University of Michigan, 1952

This investigation utilized a new technique for estimating the validity of personality evaluations based on projective techniques. Previous studies have evaluated the validity with which specific personality traits are rated on the basis of projective techniques, i.e., the accuracy with which individuals are ordered on a single continuum. In this study we have employed a relatively new statistical technique, the coefficient of profile similarity, which provides an index of the degree to which a number of personality variables are similarly ordered for a single individual on the basis of any two techniques of personality evaluation.

A series of supplementary studies was concerned with the evaluation of the possible influence of a number of factors relating to variations in the validities obtained for different individuals and by different techniques. These factors included 1) rater differences (all projective techniques), 2) face-to-face contact (Rorschach), 3) scoring categories (Rorschach), 4) shared rater stereotypes (all projective techniques).

The data were collected in 1947 in a week-long assessment program of first year graduate students in clinical psychology. The techniques selected for the present study were four projective techniques (Rorschach, Thematic Apperception Test, Sentence Completion, Bender-Gestalt), a battery of situation tests, a one hour long interview plus review of credentials, and a set of Final Pooled ratings made by the assessment staff using all information about each subject. Although admittedly fallible, these Final Pooled ratings were regarded as the most valid measures of personality available and hence were used as criteria for this study. Coefficients of profile similarity were computed for 61 subjects for all possible pairings of the seven profiles made from ratings on the 31 personality variables.

**Findings and Conclusions**

In general our findings confirm those of Samuels (1950), and point to significant but generally low validities of personality ratings based on projective techniques. Since the median validities are positive, we conclude that the behavior sampled in all of the techniques studied provides some slight basis for personality evaluation. However, the extreme range in the validity with which individuals are evaluated on any one technique and the lack of agreement between evaluations based on different techniques suggest that, pending further research, they must be used with extreme caution in the assessment of individual personality. Our findings suggest that, for any of the four projective techniques, significant validities may be expected for only about one subject in four, and as yet there appears to be no way of identifying individuals

for whom a specific technique yields significant validity. In spite of the generally low validity with which the personality of individuals may be evaluated by projective techniques, their validity may still be sufficient to make them useful in research involving group comparisons.

The profiles of personality of individual subjects based on each of the four projective techniques yielded an extremely high range of validities. The magnitude of these validities was found to be unrelated to the rater using the technique. Furthermore, there was little or no consistency in the validity with which individuals were evaluated by different techniques. In the case of the Rorschach there was no systematic difference between the validation of ratings made by the test administrator and those made on the basis of the Rorschach protocol only. Finally, Rorschach protocols yielding high and low validities did not differ significantly with respect to any of the conventional scoring categories.

The validities of personality evaluations based on the credentials-interview and the situation test procedures, while not high, are somewhat more promising than those based on projective techniques. Yet even so, these two techniques yield significant validities for less than half of the subjects studied.

The most important contribution of this investigation was the discovery of the probable basis for the wide discrepancy between the apparent and the measured validities of personality evaluations based on projective techniques. It appears that the unconscious utilization of implicit but shared stereotypes by different persons using the same or different techniques is responsible for most of the congruence between the supposedly independent personality evaluations of an individual subject.

Microfilm copy of complete manuscript of 91 pages, \$1.14. Enlargements 6" x 8", 10¢ per page.

**AN INVESTIGATION OF THE AMBIGUITY DIMENSION OF COUNSELOR BEHAVIOR**

(Publication No. 3544)

Hobart Glenn Osburn, Ph.D.  
University of Michigan, 1952

The purpose of this research has been to explore certain methods of analyzing counseling interviews with respect to the ambiguity dimension of the counselor's behavior. Secondary objectives have been to specify the manner in which the counselor structures the interview situation and to test the hypothesis that the ambiguity of the counselor's behavior tends to decrease as a function of the level of relationship with the client. The ambiguity of a stimulus has been defined in terms of the variability in the response to the stimulus by a representative sample of the individuals of a culture where in general the greater the variability the more ambiguous the stimulus. It was assumed that the counselor controls the ambiguity of the counseling process by the degree to which he specifies the attributes of the situation.

Twenty-nine typescripts of counseling interviews were utilized as the basic data of this study. These interviews were from four counselors at three levels of relationship with the client, i. e., eight first interviews, six second and fifteen third or more. The methods of analysis were to vary the level of "influence" on the data by classifying the behavior of the counselor in terms of: a) The number of counselor responses, b) Classification of the single response unit, c) Ratings based on a fairly homogeneous topic unit, and d) Ratings based on the entire interview.

The findings were:

1. The ambiguity dimensions of the counselor's behavior is a measurable aspect of the counseling process.
2. The four counselors studied in this research were significantly different in terms of the ambiguity of their behavior. Since these counselors were all from the same installation, their variability tended to be reduced. Even more striking differences could be expected among counselors with more diverse backgrounds and orientations.
3. Ratings based on a fairly homogeneous topic unit, ratings of the interview as a whole, and the objective index based on the classification of the individual responses weighted by the number of responses yielded essentially equivalent results in terms of the reliability of classification and the similarity of the phenomena they reflected.
4. No significant differences were found between the ambiguity of the counselor's behavior in the first and second interviews as compared with interviews at the third or more level.
5. Specific counseling techniques which were found to effect the ambiguity of the situation were:
  - a. The non-directive aspect of the response — defined in this study as the degree to which the counselor reflected the content of the client's previous response.
  - b. Number of responses.
  - c. The degree of specificity of the counselor's response.
  - d. The information seeking versus information giving aspects of the response.
6. The number of times the counselor initiated the topic of conversation was found to be related to the ambiguity of the interview.
7. Counselors showed a characteristic pattern in specific techniques utilized in achieving a given level of ambiguity in the interview.
8. The ambiguity of the interviews was not found to be significantly related to the productivity of the client as indicated by the total number of words spoken in the interview hour.

In general it can be concluded that varying the apparent level of inference involved in classifying the behavior of the counselor with respect to ambiguity did not produce substantial differences in the results obtained.

Microfilm copy of complete manuscript of 136 pages, \$1.70. Enlargements 6" x 8", 10¢ per page.

### THE INFLUENCE OF THE SUPERVISOR WITHIN HIS DEPARTMENT AS A CONDITIONER OF THE WAY SUPERVISORY PRACTICES AFFECT EMPLOYEE ATTITUDES

(Publication No. 3545)

Donald Campbell Pelz, Ph.D.  
University of Michigan, 1952

The general hypothesis of this study is that the supervisor's influence or power within his department — his "potential degree of control over the social environment in which his employees are functioning" — is an important determinant of whether employees respond positively to supervisory practices aimed at helping them reach their goals. The problem arose from inconclusive or contradictory results in previous analyses of the relationships between the supervisor's practices and the attitudes of employees in his work group. Data on the attitudes and practices of first-line supervisors in a large electric company were obtained from personal interviews, and attitudes of non-supervisory employees were ascertained with paper-and-pencil questionnaires.

Under influential supervisors, it was hypothesized that supervisory practices on a "goal-facilitating or hindering" continuum would show statistically significant positive correlations with several employee satisfactions. It was hypothesized that these correlations would be significantly more positive than those observed under non-influential supervisors. The differences in the relationships under different levels of influence were called "conditioner effects" of influence, and influence was termed the "conditioner" of the relationships.

The index of influence was constructed from available data on the supervisor's voice in decisions made by his superior, his non-frequency of contact with the superior, his satisfaction toward both these conditions, and his salary. Two measures of supervisory behavior were used: "taking sides with employees vs. management in cases of conflict," and "social closeness vs. social distance toward employees." Employee attitudes toward the supervisor himself, toward higher-ups in the department, and toward the work group, were used.

The data, in general, support the hypotheses. Under high influence supervisors, nineteen of twenty-eight correlations between supervisory practices and employee attitudes are positive, though small; while under low influence supervisors, twenty out of twenty-eight are zero or negative. The positive relationships under high influence supervisors are sufficiently uniform so that the total set of results is statistically significant. The positive conditioner effects — the differences observed in each correlation under different levels of influence — are again sufficiently uniform so that the total set of results is significant.

The variable of influence as such is related positively to employees' satisfaction toward the supervisor. The result is consistent with the other hypotheses if we assume that supervisory behavior in this company attempts by-and-large to facilitate employee goal-achievement rather than to hinder it.

In addition to their theoretical and methodological implications, the results have important practical implications. They suggest that to change supervisory behavior alone, when the supervisor has little power within the organizational structure, may have no effect on employee attitudes, or even a negative one.

Microfilm copy of complete manuscript of 284 pages, \$3.55. Enlargements 6" x 8", 10¢ per page.

#### RESPONSIBILITY TO THE GROUP AND ITS EFFECTS ON THE PERFORMANCE OF MEMBERS

(Publication No. 3546)

Emmy Angelica Berger Pepitone, Ph.D.  
University of Michigan, 1952

This laboratory experiment is concerned with the productivity of group members who are assigned to activities differentially important in contributing to the group's success. It is assumed that the degree of responsibility that a given member feels toward the rest of the group will depend upon his perception of the importance of his task. The hypothesis tested is that the quantity and quality of a group member's performance of his assignment is determined by the strength of his feelings of responsibility to the group.

One hundred and twenty female undergraduates served as subjects. In each of three experimentally created variations, the experimenter described to a group of four subjects two activities — "Planning" and "Sorting" — which had to be performed in order that the group could reach its goal, i. e., construct a geometric pattern. The relative importance of the two activities was varied systematically through the instructions given by the experimenter. In each experimental condition the group of four subjects was then divided into two subgroups. Each subgroup actually performed Sorting, but believed that the other subgroup was performing the Planning. Thus all groups worked on the same task, though their perception of its relative importance was varied.

In the High Condition, subjects were told that their task was highly important, while Planning which they presumably thought was executed by the other subgroup, was unimportant. In the Low Condition, subjects worked under the reverse impression. In the Medium Condition, Sorting was of moderate importance and equal in importance to Planning.

Sorting consisted of grouping seventy-two cardboard pieces into categories which represented different aspects of each piece. The quantity of performance was measured by the number of pieces sorted and the quality by the number of errors made. After subjects had worked for thirty minutes, a questionnaire was administered which asked for ratings of the importance of the tasks, the degree of responsibility, and various other personal and group motivations.

The following results were found to be reliable at acceptable levels of confidence and thus supported the empirical predictions derived from the theory:

1. The perceptions of importance of the two activities corresponded to the degree of importance described by the experimenter.

2. The degree of responsibility corresponded to the degree of importance.

3. Both the quantity and quality of productivity corresponded to the degree of felt responsibility.

Several variables were examined which might have been expected on a priori grounds to contribute additionally to the differential performance of members in the three conditions. These included: a) the influence of the experimenter, b) the difficulty of the task, c) the attractiveness of the group goal, d) the attractiveness of the group's success, e) the attractiveness of the subgroup's success, f) the attractiveness of the role, and g) the attractiveness of the Sorting Activity. The evidence indicated that none of these variables could have accounted for the differential performance in the three conditions.

Several variables were found to relate to responsibility. Various interpretations about the effects of these factors on performance were discussed. Finally noted were several implications for future research.

Microfilm copy of complete manuscript of 113 pages, \$1.41. Enlargements 6" x 8", 10¢ per page.

#### RADIOLOGY

#### EFFECTS OF ROENTGEN IRRADIATION ON INCORPORATION OF RADIOPHOSPHORUS INTO INTRACELLULAR CONSTITUENTS OF TRANSPLANTED MOUSE MAMMARY CARCINOMA

(Publication No. 3199)

Halvor Vermund, Ph.D.  
University of Minnesota, 1951

Certain aberrations in the metabolism of growing cells brought about by roentgen radiation and preceding the morphological alterations have been investigated. Refined biochemical methods utilizing modern isotopic tracer techniques and differential high speed centrifugation have been applied to the study of cell chemistry and metabolism. The biosynthesis of a number of organic compounds isolated from various fractions of the cell has been estimated by determining the rate of incorporation of radiophosphorus. Special attention has been paid to the nucleic acids in view of the increasing experimental evidence of their great importance for the physiological processes of cell division and protein synthesis.

Transplanted mammary carcinoma in homozygous mice was chosen as a suitable tissue for investigation. A specially constructed device allowed local irradiation of a tumor transplanted to the subcutaneous layer of the hind leg, while the rest of the animal and a second control tumor on the other leg were effectively shielded, receiving only between 0.1 and 0.01% of the dose delivered to the directly exposed tumor.

Analyses of the chemical composition and the relative specific activities of nucleic acids, phospholipids and phosphoproteins isolated from cell nuclei, different cytoplasmic particulate constituents and

non-sedimentable extract have been reported and comparison made with the results obtained by other investigators using normal liver tissue from adult mice, treated in an identical manner. The mammary tumor tissue has a remarkably high content of desoxy-pentose nucleic acid, which has a metabolic activity as evidenced by the incorporation of  $P^{32}$ , that is more than 70 times as great as that of liver tissue. The possible significance of this finding and other differences regarding the chemical constitution and metabolic activity of various cell fractions for the study of the process of neoplasia has been discussed.

A dose of 4500 r of roentgen rays immediately caused a decrease in the incorporation of radiophosphorus into the desoxypentose nucleic acid of directly exposed tumor tissue. This effect lasted at least five days and there was no evidence of recovery. Specific activities of 30-45% of the corresponding values for non-irradiated control samples were obtained.

In addition there was a similar but smaller suppressive effect on the incorporation of  $P^{32}$  into desoxypentose nucleic acid isolated from the shielded tumor four hours following the irradiation. Slight recovery occurred after 24 hours.

A dose of 450 r had less marked effect on the directly exposed tumor and no indirect effect on the shielded tumor was observed.

It was shown by comparison between the specific activities of the desoxypentose nucleic acid and other organic compounds, isolated from the same tissue at the same time intervals, that the roentgen radiation affects the actual synthetic processes of phosphorus-incorporation into the desoxypentose nucleic acid molecule. The decrease in the specific activity following irradiation is not conditioned by a decrease in the supply of radiophosphorus for the synthetic processes, although a slight depression of the penetration of phosphorus into the tumor cells was noted after a dose of 4500 r.

In strange contrast to the radiosensitivity of the process of phosphorus-incorporation into desoxypentose nucleic acid, the specific activities of pentose nucleic acid from cell nuclei and different cytoplasmic fractions, and of phospholipids and phosphoproteins from the corresponding fractions, have not been significantly altered within the 24 hour-interval following the irradiation.

The possible implications for the interpretation of the biological effects of ionizing radiations on living cells in general have been discussed. It was concluded that this effect is probably closely associated with the inhibition of cell growth and mitotic activity caused by ionizing radiations and thus represents an effect of fundamental biological importance.

An extensive bibliography has been included.

Microfilm copy of complete manuscript of 212 pages, \$2.65. Enlargements 6" x 8", 10¢ per page.

## SOCIAL WORK

### PREDICTION OF MEDICAL CARE COSTS FOR THE AGED: A PROBLEM IN SOCIAL WORK ADMINISTRATION

(Publication No. 3196)

Malcolm B. Stinson, Ph. D.  
University of Minnesota, 1951

#### The Problem

As the proportion of our population reaching old age increases, the problem of providing proper medical care for them assumes considerable proportions. This study sought a method for predicting from the social and physical situation of the aged person whether medical care costs for him were likely to be high or low.

#### The Design

The study was based upon the cost of the medical care provided for recipients of old age assistance in Hennepin County (Minneapolis) Minnesota during a 12 month period, November, 1949 - October, 1950. A random sample of 354 cases receiving one or more payments for medical care during that period was drawn. Data regarding age, sex, living arrangements, diagnosis, extent of physical and psychological impairment, types and costs of medical care, previous methods of payment for medical care, number of children, previous occupations, group membership, and similar items were secured. Where up to date information was available in the case record this was entered on the schedule. Other information was secured through interviews.

The design for the analysis of the data was as follows:

1. The social and physical characteristics of the group receiving medical care payments were summarized and compared where possible with data regarding all recipients of old age assistance in Hennepin County.
2. The types of medical care were summarized and the amount spent for each was analyzed.
3. The recipients of medical care were arrayed along the continuum of total cost per case for medical care provided during the 12 month period.
4. Certain social and physical characteristics of the recipients of payments above the median, \$ 72.00 per year, were contrasted with the same characteristics of persons with medical care costs of less than this amount.
5. If a characteristic appeared to discriminate between those with high costs and those with low costs, it was further tested using the highest cost quartile and the lowest cost quartile. A similar comparison was made between the highest cost decile and the lowest cost decile.
6. The critical ratio of difference between proportions was used as the test of significance in the above analysis. If the critical ratio of the difference on a single characteristic between high and low cost cases

was 2.5 or greater than this item was considered as a predictive item.

7. The method of chi-square was used throughout as the measure of association among items.

#### Results

The study indicated that age, living arrangements, physical condition, extent of impairment of decision making functions, principal diagnosis, method of paying for medical care prior to receipt of old age assistance, and the fact of belonging to social organizations discriminate between those with high and low costs for medical care and that these factors can be used to predict costs. Other items tested were found not to discriminate.

The study also indicated that 7/12 of the recipients will need at least one payment for medical care during the year but only a small proportion will need large amounts. The most expensive item in medical care, according to this study, is care. The study also showed that the arithmetic mean is a very poor measure of central tendency for the distribution of costs of medical care — the median being much more descriptive.

#### Implications of the Study Method for Social Work Administration

The study demonstrates a method by which predictions as to possible effects of a given social work policy can be made. The method may have general application to other types of problems confronting social work administrators.

Microfilm copy of complete manuscript of 118 pages, \$1.48. Enlargements 6" x 8", 10¢ per page.

#### SOCIOLOGY

#### INTERPERSONAL CONTACT AND EXPOSURE TO MASS MEDIA DURING A PRESIDENTIAL CAMPAIGN

(Publication No. 3099)

Dick H. Baxter, Ph.D.  
Columbia University, 1951

This is an investigation into the operation of interpersonal influence in the development of political attitudes, opinions and voting behavior and is concerned, too, with the role of the formal media of communication during a Presidential campaign. Data for the study were gathered by the Bureau of Applied Social Research, Columbia University, and various other agencies in Elmira, New York, and environs, in 1948 — from June through November.

The main body of the report shows the interrelationship of data regarding the extent and nature of face-to-face contact as it relates to opinion and vote formation among a representative sample of Elmira residents; it considers certain demographic and attitudinal correlates of participation in face-to-face political discussion, of different roles adopted by participants in these discussions, and of the likelihood of

having considerable influence over the political thinking of other people in the community.

Attendance to the media, generally, and to the political welfare offered by the media, is compared among people whose political discussion behavior differs. These people also are compared with regard to their more specific voting behavior. Part of the analysis is devoted to describing the homogeneity of discussants, to describing how men and women differ in their participation in discussions, to discussing the ways in which initiation of political discussion, content of the discussion, and agreement of the discussants vary according to who they are and certain circumstances regarding the discussion, and to outlining the reasons which people give for not talking politics with other people.

A section of the essay is based upon data showing variations in awareness and appraisal of interpersonal influence upon political attitudes by Elmira citizens.

The substantive appendix to the report considers the extent of exposure to the several formal mass media during the campaign, with emphasis upon the uses made of the political content of the media fare. Reasons for variations in amount of attention paid to election news and comment are elicited from these data, and an evaluation is made of the limitations and contributions of the media to the formulation of political opinion. Included here are analyses of bias of news and comment presented by the media, of reasons for vote change attributed by respondents to the media political fare, and of the image-creation function of the mass media.

Microfilm copy of complete manuscript of 542 pages, \$6.78. Enlargements 6" x 8", 10¢ per page.

#### AMERICAN FRONTIER AND PROTESTANTISM A STUDY OF PROTESTANTISM, VOLUNTARISM, AND ETHOS OF AMERICAN FRONTIER SOCIETY

(Publication No. 3110)

Tetsuo Scott Miyakawa, Ph.D.  
Columbia University, 1951

This study seeks to investigate two, perhaps three, interrelated theses. The first thesis is that the members of the leading Protestant denominations in the Western settlements of the early Nineteenth Century belonged to closely organized social groups, although this pioneer society is popularly interpreted in almost purely individualistic, indeed atomistic, terms. Actually, the evidence shows, the frontier Protestants maintained a comprehensive and often rigorous control over the personal, social, and economic life of their members and their families.

The present inquiry deals mainly with the popular Protestant denominations in the Western settlements, roughly between 1800 and 1830 or 1835, especially the period just prior to and during the initial stages of the "Age of Jackson." The "West," as used here, refers primarily to the settlements in the present states of Kentucky, Ohio, Indiana, and Illinois, and in passing, to Michigan and Tennessee. In short, the West does not mean the trans-Mississippi areas.

The first thesis has a number of further implications. Thus, it may be suggested that these Protestant denominations helped to create a society characterized by a relatively extensive resort to voluntary associations to achieve objectives not attainable by individual efforts. Again, participation in the religious societies gave the members experience in conducting and leading organized activities.

In general, the larger and more influential of the Western denominations were originally regarded in the Old World and on the Eastern seaboard as Dissenting sects. According to Troeltsch, a sect is typically marked by intimate fellowship and group discipline, but not by cosmopolitanism and world-mindedness. Characterized by strong fraternal ties within the fold, it considers itself a voluntary company of the regenerate, set apart from the society at large, for the needs of which it often cares little. Its own membership is its community. Indeed, sects may be hostile to many of the traditional cultural interests, such as the fine arts, music, drama, and popular recreation, as well as to certain functions of the state.

These comments by Troeltsch suggest the second thesis: Although originally they were Dissenting sects, the major denominations in the West helped to develop several of the traits regarded as almost typically Western, if not characteristically American. These include the indifference or hostility to abstract scholarship and learning, fine arts, and many forms of recreation, as well as the stress on lay voluntarism and participation in group activities. These traits reflect the influence of a membership composed on the whole of the culturally naive but economically rising classes without an aristocratic heritage. On the Eastern seaboard and in the Old World, the traditional cultures modified or limited the impact of these Dissenting sects. In the West, however, these sects grew successfully into large denominations and as a result exerted correspondingly greater influence, especially as no powerful establishments served to alter their outlook.

These factors are of some relevance to the theories of the Frederick Jackson Turner school. This study is not directly concerned with the discussion over the Turner concepts. Nevertheless, evidences suggest that some of the institutions regarded by the school as uniquely Western are at least partially Dissenting. The disciplinary practices, attitudes, and customs of these Western denominations were essentially national in scope but belonged to their membership which tended to be of certain social classes and strata which in the West became more influential than in the East.

These Protestant denominations in no way exerted exclusive or overwhelming causal influence. They did, however, provide organization and fellowship for their members and infused them with an ethos congenial to those interested in struggling to better their socio-economic position.

Microfilm copy of complete manuscript of 590 pages, \$7.38. Enlargements 6" x 8", 10¢ per page.

#### A STUDY OF FACTORS ASSOCIATED WITH INTER-GROUP CONFLICT IN THE LADIES' GARMENT INDUSTRY IN NEW YORK CITY

(Publication No. 3454)

Irving R. Stuart, Ph.D.  
New York University, 1951

This study investigates the relationship between economic competition and racial and nationality prejudice by examining the reported industrial experiences of different ethnic groups from 1890-1947. The ladies' garment industry, considered a traditionally "immigrant" field, was selected for intensive study of the processes by which Newcomers are integrated into various crafts which required varying levels of skill and experience. For purposes of bringing the study up-to-date, the Business Agents of the Dressmakers' Union, Local 22 of the International Ladies' Garment Workers' Union, who are concerned with adjusting grievances, were interviewed concerning the nature of the relations among the various ethnic groups which make up the 27,000 members of the union. It was understood that their reports represented value judgments.

The problem of discrimination was investigated in the light of the industrial assimilation of the Newcomer revealed in reports and observations of recognized authorities on labor, social history, and inter-group relations. The results of public and private surveys of inter-group conflicts among such major groups as the foreign-born immigrant, the American Negro, and the Spanish-speaking worker from Puerto Rico in the United States were also analyzed.

As a result of the comparison of the reports of authorities, it has been established that a commonality of experiences exists for all Newcomers, regardless of ethnic origin, who desire to enter and advance in industry. The investigation of the situation in the ladies' dress industry tended to corroborate this conclusion, also illustrating those methods by which the dominant group in an industry restricts the competition of the Newcomer.

The causes of employee discontent in the ladies' dress industry may be divided into three major groups. The first group is found among the employment relationships of the workers, for example, disputes over the distribution of work, the quality of the workmanship, etc. The second group develops from within the individual himself, e. g., his neurotic tendencies. The third major group stems from home conditions and from the social and political life of the worker away from the shop.

This study found that all of these causes of disputes were important in the growth of prejudice, but that the most important were those concerned with the employment relationships of the individual. These have resulted in the utilization of derogatory racial and nationality stereotypes by the older groups in industry when they feel that their jobs are threatened by large numbers of highly visible Newcomers. Barriers to employment in the skilled crafts are made justifiable by these derogatory stereotypes. These barriers are reinforced by the refusal of skilled

workers to train the Newcomer in the essential skills which would allow him to compete on a more equal basis, thus restricting him to the unskilled and semi-skilled crafts in the trade.

One reaction of a group against whom prejudice is displayed may be complete subservience and a disinclination to bring personal grievances to official notice. The belligerence and sensitivity of which the Negroes in the industry are accused may be aggressive reactions to the attitude of the majority in the shop. Another aspect of the same reaction may result in the irresponsibility and lack of competitive spirit which have been charged to some of these Negroes.

There is a correlation between the length of time in the trade and occupational status. Management has constantly replaced one group with another in its search for the cheapest possible labor supply. However, the ability of the employer to play one group against another has been practically eliminated in the ladies' garment industry by the union. The rate of replacement of one group by another is dependent upon the rate of attrition of the older groups in the industry. The development of different occupational goals by the Americanized children of the older groups speeds the employment of "newer" Newcomers.

Employers assist in the discrimination against Newcomers in industry as long as there is no urgent need for labor. In order to keep satisfied the skilled workers who might mean the difference between success and ruin in business, the employer will tacitly agree to the withholding of the necessary training of new workers. As soon as skilled labor is in short supply, the objections of management to the Newcomer, regardless of his ethnic origin, are rapidly dissipated, and the objections of the older workers, who fear their economic competition, are brushed aside.

It is suggested that educational programs of unions and management of large industries be keyed to the level of the workers, with emphasis upon the practical benefits derived from pension plans, social security, health and sickness insurance, and the efforts made to stabilize employment. These benefits should be particularly directed toward the older workers who are not only beset by problems connected with their decreasing abilities to compete in the labor market, but are also troubled by the psychological and physical problems of advancing age.

Continuation of this study by interviewing workers of the various ethnic groups in the ladies' garment industry is warranted so that their views upon relations between the groups in the trade might be compared with those of the Business Agents.

Another study which has been suggested by this investigation is one which would investigate the acceptance of Americans of Italian descent in white collar occupations which might be related to the reported decline in the membership of the Italian Dressmaking Union.

Microfilm copy of complete manuscript of 226 pages, \$2.83. Enlargements 6" x 8", 10¢ per page.

## S P E E C H

## A COMPARISON OF STUTTERERS AND NON-STUTTERERS ON SEVERAL MEASURES OF ANXIETY

(Publication No. 2792)

John Louis Boland, Jr., Ph.D.  
University of Michigan, 1952

This study is concerned with the relationship between anxiety and stuttering. Specific questions that have been asked are:

1. How do stutterers differ from non-stutterers in the amount of general or chronic anxiety they experience?
2. How do stutterers differ from non-stutterers in the amount of anxiety they experience about speech-centered, interpersonal situations?
3. What is the relationship between self rated competence in speech situations and amount of anxiety experienced in connection with speech situations?
4. What is the relationship between amount of anxiety experienced in connection with speech situations and the amount of general or chronic anxiety, for stutterers and non-stutterers?

The measures of general anxiety were all derived from Minnesota Multiphasic Personality Inventory responses. Specifically, these measures of general anxiety are: Welsh's Anxiety Index, Taylor's Manifest Anxiety Scale, Modlin's Neuroticism Index, and Janda's Expressor-Repressor Ratio. The measure of speech anxiety, the Speech Anxiety Projective Test, was devised for use in this experiment. In addition, a Self Rating Scale was devised to measure self judgments about competence in speech situations.

The conclusions reached by this study are:

1. The degree of "neuroticism" (as measured by the Neuroticism Index) does not differentiate stutterers from non-stutterers.
2. Stutterers, when compared to non-stutterers, tend to prefer to express anxiety overtly rather than to repress or indirectly express anxiety.
3. The level of chronic or general manifest anxiety (as measured by the Welsh Anxiety Index and the Iowa Manifest Anxiety Scale) is higher in stutterers than in non-stutterers ( $P < .05$ ).
4. The level of anxiety associated with speech situations (as indicated by the Speech Anxiety Projective Test) is significantly greater in the stuttering group than in the non-stuttering group.
5. Relatively low correlation coefficients obtained between measures of general anxiety and the measure of speech anxiety suggest that these two kinds of anxiety may be relatively independent.
6. Persons with high levels of speech anxiety tend to rate themselves as less competent in speech situations (as measured by the Self Rating Scale). The correlation coefficients are low enough, however, to indicate that speech anxiety may be a relatively minor factor in self-judged competence in speech situations.

Microfilm copy of complete manuscript of 144 pages, \$1.80. Enlargements 6" x 8", 10¢ per page.

**A MEASURE OF THE SALIENCY AND CONTENT  
OF OPINION TOWARD PUBLIC SPEAKING**

(Publication No. 3506)

Lawrence William Grosser, Ph. D.  
University of Michigan, 1952

This study was undertaken to answer two primary questions: 1) To what degree is public speaking salient for the average college graduate? 2) What is the content of his opinion? By saliency is meant prominence or the degree to which the opinion is uppermost in the minds of the respondents. The principal consideration in an examination of the content of graduates' opinions is to establish the degree of proness or con-ness of opinion toward the importance of public speaking as a skill and as a desirable course in the curriculum. The field of speech was restricted to platform speaking alone and to those outcomes associated with the practical course.

The writer utilized the current methodology of public opinion research. The total population consisted of graduates from the College of Literature, Science, and the Arts with A. B. or B. S. degrees granted during the period from 1921 to 1941. The population was sampled, face to face interviews were employed in gathering data, data were analyzed by coders and arrayed by tabulators using International Business Machines. Bias control was undertaken through the use of non-suggestive open-end questions administered in the field using the techniques of secrecy and anonymity.

The schedule of questions incorporated items of three kinds: those tendered to 1) all respondents; 2) respondents with previous training public speaking; 3) respondents with no training — high school and extra-curricular activities excepted. The conclusions are arrayed in corresponding form.

**All Respondents**

1. A satisfactory high degree of crystallization of opinion was noted.
2. In saliency, although only a rough measure was attempted, public speaking ranked high, standing second only to English in number of times mentioned.
3. A majority of respondents held public speaking important. Of the total sample ninety-one accorded it either high or highest in importance, five thought it important in some ways but not in others, and only three considered it unimportant or unimportant with qualifications.
4. The intensity of these opinions was reflected in the number of respondents (eighty-nine) who would urge students entering college to take training public speaking. A majority also believed that speech should be a required course for all students and for either one or two semesters.

**Respondents With Previous Training**

5. A high degree of satisfaction with the kind of speech training these respondents had had was evident. The majority had enjoyed their work and thought it valuable. Few believed that the amount of training they had elected had been sufficient.

**Respondents With No Training**

6. The majority of graduates without training expressed the wish that they had taken training while in college. The remainder were divided among those who had had enough in high school and those who for reasons of fear could not face the problem.

7. The values of training public speaking were viewed realistically by those with no training. A comparison of the "expressed" values of those with training and the "hoped for" values of those without training showed an extremely close parallel.

Microfilm copy of complete manuscript of 95 pages, \$1.19. Enlargements 6" x 8", 10¢ per page.

**THE RHETORICAL THEORY OF  
JOHN CARDINAL NEWMAN**

(Publication No. 3526)

Reverend James Hugh Loughery, Ph. D.  
University of Michigan, 1952

The purposes of this study are:

1. To organize systematically Cardinal Newman's theory of rhetoric,
2. To relate Newman's rhetorical theory to the classical tradition by comparing and contrasting it with the doctrines of Aristotle, Cicero, Quintilian, and St. Augustine,
3. To determine the contributions made by Newman to the field of rhetorical theory.

The study by its nature involves the investigation and analysis of Newman's writings. Newman's rhetorical theory is extracted from his works and is organized under the five traditional categories of invention, arrangement, style, memory, and delivery. Each of these categories is concerned with the following considerations: 1) Newman's theories on rhetoric as expressed in his lectures and writings; 2) comparison between Newman's theories and those prominent and important in the rhetorical tradition; and 3) statements indicative of Newman's position relative to the classical tradition.

The general conclusion is that Cardinal Newman's

works contain a complete theory of rhetoric and that his theory is in substantial agreement with the classical tradition as represented by Aristotle, Cicero, Quintilian, and St. Augustine. In all his definitions and divisions of the art of rhetoric, Newman represents essentially the classical rhetorical doctrines. He states that rhetoric is concerned with the probable and that its end is persuasion. Newman distinguishes rhetoric from logic, poetry, and grammar. He holds that while logic, poetry, and grammar have some points of contact, they should be distinguished from rhetoric according to the formal objects of these respective arts. Although Cardinal Newman discusses each of the five phases of rhetorical theory, his treatment of the emotions and delivery is more brief than the consideration given to these in the works of the classical writers.

Newman's theory adheres to the persuasion-conviction duality and to the Aristotelian-Thomistic interpretation of the indirect influence of the feelings upon movement of the will. Newman signifies that the more rude and ordinary feelings are proper to rhetoric, and names anger, indignation, emulation, martial spirit, and love of independence as pertinent to rhetoric. He firmly opposes the indiscriminate excitation of the emotions.

Newman develops the element of preparation with special reference to the preacher. His treatment is more thorough and more extensive than that of all the representatives of the classical tradition except Quintilian. Newman states that not only general preparation of the speaker is necessary, but also special preparation for each speech situation.

Like Aristotle, Newman considers the speaker as the keystone of the actual rhetorical situation. He believes that the ethos of the speaker is the most powerful means of persuasion in deliberative oratory. He specifically mentions that the speaker persuades not only by what he says but by what he is. In naming the theological virtues of faith and love the source of good character, Newman adds to the traditional concept of ethos.

Microfilm copy of complete manuscript of 358 pages, \$4.48. Enlargements 6" x 8", 10¢ per page.

#### THE EFFECT OF GROUP SIZE ON DECISION-MAKING DISCUSSIONS

(Publication No. 3534)

Newton Edd Miller, Jr., Ph.D.  
University of Michigan, 1952

This is an experimental study of the relationship between size of the group and certain group process

and group outcome variables in decision-making discussions.

It was hypothesized that the larger a group became: 1) the fewer opportunities there would be for individuals to talk; 2) the more frustrated members would feel about participation; 3) the more unequal would be the spread of participation; 4) the greater would be the formation of cliques; 5) the less would be the perception of unity of the group; 6) the less would be the feeling of belonging to the group; 7) the less would be the perception of the group as an aid in problem solving; 8) the less would be the feeling of acceptance by other members of the group; 9) the fewer would be the number of decisions reached by the group; 10) the better would be the quality of the decisions reached; 11) the less would be the satisfaction with the meeting as a group meeting; 12) the less would be the satisfaction with decisions reached by the group.

Subjects were 184 male college students enrolled in beginning speech courses at the University of Michigan. Subjects were placed in groups ranging in size from three member groups to twenty member groups. Each group discussed the same problem, analytical in nature, which involved the making of many decisions. Pearson Product Moment Correlations were run between size and the variables implicit in the hypotheses.

Results indicate that there is a high negative correlation between size and opportunities to talk in a discussion and between size and group cohesiveness (group unity, belonging to the group, group acceptance, group helpfulness). There is a high positive correlation between size and the number of cliques. Inter-correlations among the variables indicate that this kind of phenomenon operates when size of the group is manipulated: size is one factor affecting frustration about participation and through the operation of certain intermediate variables (cohesiveness, number of cliques) it has an effect on member attitudes toward outcomes, although there is no direct relationship between size and these attitudinal outcomes. Size, within the limits of the groups studied, apparently in no way affects objective measures of group decisions (number of decisions, quality of decisions).

Microfilm copy of complete manuscript of 68 pages, \$1.00. Enlargements 6" x 8", 10¢ per page.

## ZOOLOGY

THE STATUS, ECOLOGY, AND UTILIZATION  
OF THE CONTINENTAL  
BARREN-GROUND CARIBOU  
(*Rangifer arcticus arcticus*)

(Publication No. 3465)

Alexander William Francis Banfield, Ph. D.  
University of Michigan, 1951

The present investigation was undertaken for the Canadian Wildlife Service, Department of Resources and Development, during 1948 and 1949. The purposes of the investigation were: to obtain quantitative data on the present status and the change in status of the caribou in recent years; to assess native utilization and the dependence of the human population upon this resource; to expose the facts of its life history and clarify its role in the northern biotic communities with special reference to the effects of wolf predation.

Information on the former status was obtained from a review of the exploratory literature and unpublished reports. Data on the present status were obtained from aerial transects during migration periods with the aid of aerial photography. Vital statistics of the herds were obtained from segregated counts on the ground and from photographs. Observations were also made at numerous ground stations throughout the range. Range studies were conducted. Post-mortem examinations, including stomach contents, were made on specimens and hunters' kills. Series of annual questionnaires and native game returns were analysed.

The present population of barren ground caribou was estimated to be about 670,000 animals. This was thought to constitute a 62 per cent decrease in population during the last 50 years. The winter range included about 295,000 square miles of tundra and taiga, while the summer range included about 300,000 square miles, giving an estimated density of about 2.2 animals per square mile of occupied range. The average annual increment was calculated to be about 21.6 per cent of the herds, or 145,000 calves.

From the analysis of stomach contents samples and range studies, it was determined that the following plants had a high summer palatability: *Equisetum* sp., *Cladonia* sp., *Cetraria* sp., *Salix* sp., *Carex* sp., *Betula glandulosa*. Post-mortem examinations revealed the following incidences of parasitic infection. *Oedemagena tarandi* - 100 per cent, *Cephanomyia nasalis* - 24 per cent, *Taenia hydatigena* - 40 per cent, *Taenia Krabbei* - 28 per cent, *Echinococcus granulosus* - 3 per cent, *Dictyocaulus viviparus* - 24 per cent. Evidences of infections of tuberculosis and actinomycosis were also observed.

Scanty data indicated an approximate loss of 25 per cent per annum of a single herd from wolf predation. It was considered unlikely that this factor would account for more than 5 per cent losses per annum; accidents and weather conditions were thought to be important reduction factors.

The social structure of the caribou herds, migration behaviour, and effects upon other birds and

mammals are discussed. The human harvest was determined to be about 100,000 caribou per annum. This total figure was further analysed to include: Eskimo kill - 30,000, Indian kill - 50,000, "White" kill - 20,000.

It was concluded that the decrease in the caribou population was because of the increased proficiency of modern firearms in the hands of the natives and the changed native economy brought about by the introduction of the fur trade. With the exception of forest fires, man has little influenced the environment. Future management should be directed mainly towards limitation of the human kill and reduction of the present wastage.

Microfilm copy of complete manuscript of 351 pages, \$4.39. Enlargements 6" x 8", 10¢ per page.

THE RELATION OF TEMPERATURE TO THE ALTITUDINAL DISTRIBUTION OF FROGS AND TOADS IN SOUTHEASTERN WYOMING

(Publication No. 3468)

George Theodore Baxter, Ph. D.  
University of Michigan, 1952

In southeastern Wyoming, a study was made of the ecology and altitudinal distribution of the western chorus frog, *Pseudacris nigrita triseriata* (Wied), the northwestern toad, *Bufo boreas boreas* (Baird and Girard), the Manitoba toad, *Bufo hemiophrys* Cope, the leopard frog, *Rana pipiens* Schreber, and the northern wood frog, *Rana sylvatica cantabrigensis*.

The area includes the Laramie Basin at an elevation of 7,200 to 7,500 feet, bordered by mountains whose highest peak reaches 12,005 feet. Vegetational belts from the Basin up to the highest elevations of the mountains are: a mixed-grass plains, a foothills belt, a montane belt, a subalpine belt, and an alpine belt. The 10,500 foot contour in the upper subalpine belt marks the upper limits of the ranges of the western chorus frog and the northwestern toad. The Manitoba toad is found only on the plains. The leopard frog ranges up to 9,000 feet in the montane belt, and the northern wood frog is restricted to between 8,500 and 10,000 feet in the montane and subalpine belts.

Weather records from four United States Weather Bureau stations were supplemented by measurements of air and water temperatures by means of thermographs, and evaporation rates measured with atmometers.

The following annual mean temperatures have been recorded at the weather stations: Laramie, at 7,188 feet on the plains, 41.0° F.; Centennial, at 8,176 feet in the foothills, 39.2° F.; Pole Mountain Nursery, at 8,530 feet in the montane belt, 37.2° F.; Foxpark, at 9,060 feet in the montane belt, 32.4° F. Mean daily and annual temperatures decrease regularly, and precipitation increases in amount and uniformity of distribution as altitude increases.

Eggs of the anurans were reared at controlled temperatures to determine developmental rates.

Weekly series of tadpoles collected from the study stations were weighed and developmental stages recorded. Growth of adult leopard frogs was estimated from length-frequency distributions, and age at attainment of sexual maturity of this species was determined from examination of gonads.

Except for the Manitoba toad, the rate of development of eggs is correlated with the length of growing season at the altitudinal limits of the several species. For any species, the tadpole period at the upper limit of its altitudinal distribution requires the entire growing season for completion; it begins later and is extended over a longer period at higher elevations. Estimated growth of the leopard frog is somewhat slower at higher elevations; an additional year is required of this species for sexual maturity of the females at 8,500 feet as compared with those at 7,200 feet.

Freezing temperatures, causing mortality to hibernating animals, and the interrelation of temperature with humidity as related to activity, probably influence amphibian distribution in the region. The most important influence of temperature on the altitudinal distribution of amphibians in this region is the length of the growing season, which is determined by the annual march of daily temperatures, and prevailing air and water temperatures during the growing season which determine the rate of development of eggs and larvae, and rate of growth and time of sexual maturity of adults.

Microfilm copy of complete manuscript of 167 pages, \$2.09. Enlargements 6" x 8", 10¢ per page.

#### TAXONOMIC STUDIES ON THE FAMILY OCHEOTOSOMATIDAE LEAO, 1944, AND THE LIFE HISTORY OF STOMATREMA GUBERLETI BYRD, 1937. TREMATODA

(Publication No. 3502)

John David Goodman, Ph.D.  
University of Michigan, 1952

The study has been divided into two parts - a taxonomic revision of the subfamily Ochetosomatinae Leao, 1944, including a systematic review of the family Ochetosomatidae Leao, 1944 and related trematode groups, and the life history of Stomatrema guberleti Byrd, 1937.

Part I includes a historical summary of the subfamily Ochetosomatinae from the earliest description of a member of the group to the present. In the revision section it became necessary to alter certain taxonomic designations. Travtrematinae nom. nov. replaces Leptophyllinae Byrd, Parker, and Reiber, 1940 (the genus Leptophyllum Cohn, 1902 is preoccupied by Leptophyllum Verhoeff, 1899). Macroderinae nom. nov. is established for the reception of Macrodera Looss, 1899 and Natriodera Mehra, 1937, and the subfamily is placed in the family Plagiorchidae Luehe, 1901. Natriodera variabilis (= Dist. variabile Var. a Leidy, 1856) replaces Natriodera (= Macrodera) verlatum Talbot, 1934. Neorenifer

heterodontis Byrd and Denton, 1938 is considered a synonym of Ochetosoma zschorkei (Volz, 1899). Renifer acetabularis Crow, 1913 and R. orula Talbot, 1934 are considered identical with Neorenifer aniarum (Leidy, 1890). Dasymetra naticis (Holl and Allison, 1935) comb. nov., replaces D. nicolli Holl and Allison, 1935. Lechriorchis validus Nicoll, 1911, L. inermis Lebour, 1913, and Renifer sp. Job, 1917, are considered synonyms of O. elongatus (Pratt, 1903). Three new species have been described; O. lampropelti sp. nov. from Lampropeltis getulus floridana, O. rauschi sp. nov. from Akistodon piscivorus, and Pneumatophilus tracheophilus sp. nov. from Farancia abacura. The origin and distribution and phylogenetic relationships of the family are speculated upon. Keys are presented for the separation of certain of the groups.

Part II, the life history of Stomatrema guberleti Byrd, 1937, gives data on the ecology and distribution of the hosts. Physa (Physella) halei is the host of S. guberleti in Louisiana and Texas and of S. pusilla in Georgia and Florida. P. gyrina is the host of S. guberleti (= S. faranciae) at Reelfoot Lake, Tennessee. The second intermediate hosts in nature are Amphiuma and Siren of southern United States. The final position of the adult worm is the mouth and esophagus of the Mud Snake, Farancia. Infections are established in snails when the eggs of the parasites are expelled from the snake, either by way of the mouth or with the feces into the water, and are eaten by the appropriate physid snails. In a short time the miracidia have escaped from the eggs and penetrated the wall of the stomach and intestine. The mother sporocysts develop into large, saccular structures on the wall of the stomach or intestine of the snail. After about twenty days of development the daughter sporocysts, containing cercarial embryos and cercarial germ balls migrate from the mother sporocyst mass to the snail liver. These migrating daughter sporocysts are covered by a distinct layer of cells, the paletot. They are extremely mobile and distinct from any of the preceding or subsequent stages of development. Within ten days after reaching the liver of the snail, in summer, mature cercariae are being liberated into the water. Cercarial liberation occurs primarily at night, corresponding to the period of greatest activity of Amphiuma and Siren. The cercariae enter the buccal and cloacal openings of these amphibians and encyst on the wall of the mouth pharynx and cloaca. Metacercariae were never observed in any location other than the mouth and cloaca, either from experimentally or naturally infected animals. The snake becomes infected when it eats the amphibian. The primary articles in the diet of the Mud Snake are known to be Amphiuma and Siren.

The correct taxonomic position of the genus Stomatrema has been in dispute since its erection by Guberlet in 1928. With the completion of the present study it can now be placed without further hesitation in the subfamily Ochetosomatinae Leao, 1944 (= Reniferinae Pratt, 1902).

Microfilm copy of complete manuscript of 322 pages, \$4.03. Enlargements 6" x 8", 10¢ per page.

**DIOCTOPHYMA RENALE (GOEZE, 1782)**  
**A STUDY OF THE MIGRATION ROUTES**  
**TO THE KIDNEYS OF MAMMALS**  
**AND RESULTANT PATHOLOGY**

(Publication No. 3507)

Carl William Hallberg, Ph. D.  
 University of Michigan, 1952

The problem includes an investigation of the routes of migration to the kidneys of mammals followed by the infective larvae of the nematode worm, *Dioctophyma renale*, and the pathology of the migration in the host tissues.

Over 1100 bullheads, *Ameiurus natalis* and *Ameiurus melas*, were collected and autopsied to obtain the infective larvae which encyst in their mesenteries. Only 22 larvae were secured and these were fed to six laboratory animals, ferrets and kittens. Experimental infections were achieved. Investigations of the course of migration through the organs of the host were made as well as studies of the pathology of the infected tissues. The tissues were fixed, sectioned, stained, and examined microscopically.

Investigations were made of natural infections in wild mink. A total of 26 mink were examined, 16 of which were infected by kidney worms. A summary of the incidence of kidney worms in animals studied at the University of Michigan was made and brought up to date. Of 442 animals examined, 43 were infected, 9.2 per cent. A total of 84 adult worms were recovered, 46 males and 38 females. There was a percentage of 85.72 in the right kidneys, 4 worms in left kidneys, and the remainder in the abdominal cavity. All of the animals with the exception of one dog and four cats were in the Mustelidae.

Points of entry into the right kidneys of two wild mink were found to be on the side of the kidney nearest the midline of the body of the host at a point midway between the hilus and the anterior apex. The paths of migration were characterized by a production of scar tissue, hemorrhagic infiltration, involution of the connective tissue which surrounds the kidney at the point of invasion, and little evidence of necrosis. The entrance into the right kidney was found in the region where the first loop of the duodenum lies in close proximity to the hilus of the kidney. A study was made of sectioned tissue of a duodenum in which Woodhead (1950) found a 30-mm young adult kidney worm one-half emerged from the duodenum. The posterior portion of the worm was still within the duodenum at the time of autopsy. Evidence indicated the mechanism of escape to be a lytic action upon the host tissue.

Evidence indicates that the normal migration route of the infective larvae in the mammalian host is as follows: (1) excystment of the larvae in the stomach subsequent to ingestion, (2) passage through the pyloric sphincter into the first loop of the duodenum, (3) penetration through the wall of the duodenum in the region where contact is made with an area of the right kidney midway between the hilus

and the anterior apex, (4) migration through the capsule and wall of the kidney into the pelvis.

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**IN VITRO ANALYSIS OF DIFFERENTIATION  
 OF RETINAL PIGMENT IN THE  
 DEVELOPING CHICK EMBRYO**

(Publication No. 3158)

John Robert Harrison, Ph. D.  
 University of Minnesota, 1951

Conditions for retinal pigment production in explanted chick embryonic eyes were studied. Yolk-albumen, albumen, and embryonic extract media proved adequate with eyes as early as the 4 somite stage. A basal glucose medium was inadequate for eyes from embryos of 22 somites or less. These young eyes could be forced to pigment on 1cc of glucose medium by crowding more than one. Two factors were shown to be involved, a growth and a pigmentation factor. Dialysis, fractination by centrifugation, and heat treatment of embryo extracts showed these factors to be dialyzable, free in the cytoplasm, and heat stable. They are present in young embryos (less than 24 somites) as well as older embryos (8 day). Pretreatment of young eyes on the glucose medium and in buffered saline showed that the pigment capacity is not lost until the tissue is killed. Homogenate-colorimetric studies showed that tyrosinase activity appears between the 3rd and 4th days. Pigmentation in young eyes was not affected by tyrosine or dopa when tested in buffered solutions and on supplemented glucose medium. Histological preparation of explants showed characteristic features of normally developing eyes. In addition to the normal intracellular pigment, there occurred an extracellular pigment granule formation coincident with cytolysis of mesenchymal head tissue. From a statistical comparison of right and left eyes for first appearance of pigment *in vitro* it was concluded that there is an inherent tendency for the right eyes to pigment first.

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**CARYCHIUM EXIGUUM (SAY) OF LOWER  
 MICHIGAN; MORPHOLOGY, ECOLOGY,  
 VARIATION AND LIFE HISTORY  
 (GASTROPODA, PULMONATA)**

(Publication No. 3509)

Harold William Harry, Ph. D.  
 University of Michigan, 1952

This study concerns the general biology of *Carychium exiguum* in Lower Michigan. Special emphasis is placed on its morphology. Animals were collected from more than sixty localities in the state.

Problems relating to collecting, culturing the snails in the laboratory and preserving material for morphological studies, as well as special techniques for studying Carychium are discussed. Carychium exiguum was found to have a short phenological period in July. Immature specimens were present in nature in quantities greater than ten per cent only until November. Darkness, constant high moisture and decaying vegetation appear to be the essential factors in their environment. As isolated colonies Carychium occurred in microhabitats which were found chiefly in Thuja forests, open grassy areas and some hardwood forests.

From a study of variation of the shell it was concluded that criteria previously used for distinguishing nominal species in this area are not sufficient for recognizing more than one biological species. No anatomical differentiation of species was found. Changes in the shell during growth are recorded. Carychium, unlike other Ellobiacea studied, showed no evidence of heterostrophy. Resorption of the internal partitions of the shell and perfection of the lamellae proceeded with growth.

In the animal there is a fusion of the whorls of the visceral mass which corresponded to the amount of resorption of the shell partitions. This resorption process corresponds to the insertion of the columellar retractor muscle, the upper extent of the pulmonary cavity and, together with certain innate characteristics of the spire itself, helped delimit the apical portion of the spire as a unit, forming the upper visceral complex. That portion of the hemocoel connecting this upper visceral complex and the cephalopedal mass was found to be divided farther into two longitudinal portions by the encroachment of the shell lamellae on the diaphragm.

In general, a simplification of structure was observed in the internal anatomy and this trend was especially noticeable in the reduction of branching of the ovotestis, liver and salivary glands. Musculature was present in the digestive tract only in the region of the stomach and buccal mass. In the circulatory system the heart was similar to that of other pulmonates, but in the arterial system only the rudiments of the major arteries were present. The venous system was without any vascularization in the pulmonary cavity except the pulmonary vein. There was a spacious marginal mantle sinus which seemed to be the chief site for external respiration. The left pallial vein conveys blood directly from that sinus to the pulmonary vein, joining it just before the latter empties into the auricle.

The nervous system was more diffuse than in most other Pulmonata. There were two accessory cerebral ganglia which were not comparable to the tripartite cerebral ganglia of either Helix or Lymnaea. Chiastoneury was manifest in the visceral nerve ring which contained pleural but not parietal ganglia. The sensory epithelia at the tip of the tentacles and margin of the labial palps were identical in structure. The latter may be homologous with the tentacular pads of the Ellobiidae or sensory areas in other Basommatophora.

Two sexual types were found and both contained

sperm and ova in their gonad. The reproductive system of the aphallate type was characterized by a unicellular gonad, the absence of a seminal vesicle, vas deferens or penis. The phallate specimens had a plurifollicular gonad, a seminal vesicle, vas deferens and penis. A homologue was found which corresponds to the mantle organ which Plate first described in Pythia. It contained a tube in phallate specimens which is lacking in the aphallate ones. A muscular and glandular modification of the parietal isthmian hemocoel in the phallate specimens is also lacking in the aphallate ones. The ratio of the two sexual types vary in different colonies.

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THE LIFE HISTORY OF  
GORGODERA VIVATA N. SP.  
(TREMATODA: GORGODERIDAE)

(Publication No. 3511)

John Steger Hunt, Ph. D.  
University of Michigan, 1952

A styled, macrocercous cercaria belonging to the Gorgoderinae (Trematoda: Gorgoderidae) was found to emerge from 9.4 per cent of 14,761 fingernail clams, Sphaerium simile (Say), collected from 4 areas in the Huron and Raisin River drainages in the vicinity of Ann Arbor, Michigan. This is the first report of this clam species as a host for a gorgoderid trematode. These cercariae developed into metacercariae in 100 per cent of Sialis sp larvae, in 56.6 per cent of the crayfish, Cambarus immunis, in 95.6 per cent of anisopteran naiads (Leucorrhinia proxima?), Libellula (pulchella?), Libellula luctuosa, and Erythemis simplicicollis) when they were ingested by these arthropods. Naiads of Gomphus lividus could not be infected and those of Anax junius were not found infected in nature but 40 per cent of those exposed experimentally became infected.

Percentages of the numbers of cercariae that were recovered as metacercariae in the several second intermediate hosts were determined, also the distribution of metacercarial cysts in second hosts. The rates of infectivity of cercariae of various ages were determined.

Several species of snails and tadpoles, reported as second hosts for other gorgoderids were exposed to cercariae with negative results.

Metacercariae were fed to the frogs, Rana pipiens and R. palustris with negative results, but sexually mature worms were recovered from the urinary bladders of R. clamitans. Sexually mature adults developed in 20 out of 21 laboratory-reared R. clamitans that were exposed to experimentally produced metacercariae. Adults were recovered from 3 out of 7 laboratory-reared R. catesbeiana that were exposed to metacercariae. Miracidia were easily obtained from the urine of infected R. clamitans but were never recovered from the urine of R. catesbeiana. Age of infectivity of metacercariae

was determined and data on excystation obtained.

Size of eggs and of living and fixed miracidia was determined. Silver nitrate preparations revealed the epidermal plates in 3 rows of 6-6-3. Rate of motion, reaction to light, and longevity were experimentally determined.

Daughter sporocysts are described and means and ranges of numbers present in infected clams are presented.

The cercaria that swims continuously for several hours after emerging is described. Rate of motion, reaction to light, longevity, and time of emergence were experimentally determined. Structural differences are listed that distinguish the cercaria from all other styled, macrocercous cercariae that have been described.

The metacercaria and its cyst are described.

The adult which resembles Gorgodera amplicava differs in the range of variation of shape of ovary and vitellaria.

The excretory system of cercaria, metacercaria, and adult is described.

Because (1) the clam host is different from that reported for any other gorgoderid trematode, (2) the cercaria differs structurally and in the ability to swim continuously for a time, from all other described gorgoderid cercariae, and (3) the adult possesses characters with a wider range of variation than that reported for Gorgodera amplicava which it resembles, it is believed that this trematode is a new species for which the name Gorgodera vivata is proposed.

Microfilm copy of complete manuscript of 149 pages, \$1.86. Enlargements 6" x 8", 10¢ per page.

#### SOCIAL BEHAVIOR, SOCIAL ORGANIZATION, AND POPULATION DYNAMICS IN A BLACK-TAILED PRAIRIEDOG TOWN IN THE BLACK HILLS OF SOUTH DAKOTA

(Publication No. 3519)

John Arthur King, Ph. D.  
University of Michigan, 1952

Recent investigations have suggested that social behavior may play an important role in controlling population density. In order to learn more about this role, a study of the social behavior and social organization of the black-tailed prairie dog was undertaken in the summer of 1948 and continued during each summer of 1949 and 1950. Observations were also made in the winter and spring of 1950. The study was made on approximately five acres of a large prairie dog town located in Wind Cave National Park, South Dakota. All of the inhabitants on this study area were live trapped and their social behavior and population fluctuations were recorded.

A prairie dog town is characterized by numerous burrows and by a depletion of the original grass cover and its replacement in part by forbs. On 9.4 acres of the Shirttail Canyon town, the density of prairie dog burrows was 57 per acre in 1948.

Prairie dogs spend an average of 57 per cent of their active day feeding. A variety of species of plants are used for food, forbs being among the most important.

The number of prairie dogs on the study area fluctuated throughout the three years of study from 4 to 15 individuals per acre, with an average density of 8.9 individuals per acre. The ratio of males to females of the young when they emerged from their natal burrows was 1.5 : 1.0 for the period of study. The ratio for the adults was 0.8 : 1.0. Mortality is low among the young during their first summer. Before the first year of life, however, mortality increases, particularly among the males. Predation was only a minor cause of mortality among the prairie dogs during the period that the study area was under observation.

The prairie dog population of the town is divided into discrete social units, here called coteries, which contain from 2 to 35 individuals, with a mean of 8.5. The territory occupied by a coterie is defended against non-members. The average size of a coterie territory was 0.70 acre, which is also the mean home-range for each member. Movements are unrestricted within the territory. The mean distance travelled per day by seven individuals whose movements were recorded was 5,524 (3,200 - 14,112) feet.

Members of the same coterie are well integrated by their responsiveness to social stimuli. Some co-operation among the prairie dogs exists. There is little competition or aggression within the coterie.

Social relations between members of neighboring coterie territories are antagonistic in the defense of their respective territories.

Expansion of prairie dog towns into adjacent uninhabited areas is accomplished by the immigration of adult individuals, who come from older sections of the town. Expansion prevents depletion of the food resources within the old town, which otherwise would result from overcrowding.

The social behavior of prairie dogs, including the defense of territories, is a mechanism which regulates their local population density.

Prairie dogs are adapted to their environment because of their ability to control such features as the height of the vegetation, the relative amounts of grasses and forbs, and the number of their burrows. Their exposure to predation is reduced by their social habits and by their modification of the habitat. These results can only be accomplished through the combined activity of a group of these animals. Social behavior and social organization consequently are very important factors in the adaptation of prairie dogs to their environment.

Microfilm copy of complete manuscript of 342 pages, \$4.28. Enlargements 6" x 8", 10¢ per page.

THE MOLLUSCAN FAMILY SUCCINEIDAE  
IN MICHIGAN, CONSIDERATIONS OF ANATOMY,  
EARLY EMBRYOLOGY AND DISTRIBUTION

(Publication No. 3524)

Charles Bruce Lee, Ph.D.  
University of Michigan, 1952

This study of the molluscan family Succineidae in Michigan contains a reevaluation of the species and forms previously established on the basis of shell characters. Since relationships can not be determined solely by shell structure, the morphology of the genital system was studied. Special emphasis was placed on the structure of the male genitalia. The morphological arrangement of these organs during mating was sufficiently characteristic to warrant the establishment of a new subfamily, the Quickellinae, and the affirmation of an established one, the Succineinae. The latter in Michigan contains two genera, Succinea and Oxyloma. The suitability of Oxyloma retusa (Lea) as a laboratory animal permitted studies which revealed that during copulation the same animal may function either in an active or a passive role. Also, this species was used to study the internal anatomy of copulating pairs, the size difference of mating animals, and the variation in the rate of heart beat during copulation.

A comparison of the methods of copulation among the Succineinae, as represented by Succinea ovalis Say and Oxyloma retusa (Lea), with that of the Quickellinae, as shown by Mediappendix vagans (Pilsbry), revealed striking differences. Among the hermaphroditic Succineinae mating was internal and the exchange of sperm reciprocal, a relationship generally referred to as gynandromamous. In contrast, copulation in Quickellinae was external and due to the absence of the penis the sperm were transferred by a transient, special organ, the spermatogogue. A difference also occurred in the mating activity in that the Succineinae were diurnal while the Quickellinae were nocturnal. In addition the studies of the early embryology of Oxyloma retusa (Lea) (Succineinae) showed that the eggs were enclosed in gelatinous masses, while in Mediappendix vagans (Pilsbry) (Quickellinae) such gelatinous coverings were lacking.

The early embryonic development of Oxyloma retusa (Lea) was observed from the time of egg deposition through the stages involving the ejection of the polar bodies, the early blastulation, gastrulation, and the beginning of organ formation. Many of these stages are shown by photographs made from developing embryos. Eggs hatched in 9 to 11 days. The life span of Oxyloma retusa (Lea) was found to be 12 to 18 months.

The morphological changes in the structure of the hermaphroditic gland of Oxyloma retusa (Lea) were observed throughout a yearly cycle. This gland passes through three stages in the production of eggs and sperm, i.e. a period of proliferation, a stage in which the genetic products break down, and a season of hibernation.

The evidence available from both the geological

record and the present distribution of these snails indicates that in North America the earliest fossil remains occur in the Pliocene of Kansas. The former ranges were considerably altered due to Pleistocene glaciation. However, in the Palearctic region the Succineinae appear to have reinvaded their previous range, while in the Nearctic region both the Succineinae and the Quickellinae evidently recovered their former ranges. The genera Oxyloma and Mediappendix are Palearctic groups. Oxyloma retusa appears to be conspecific with the Eurasian Oxyloma elegans Quick.

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LIFE HISTORY OF  
GIGANTOBILHARZIA HURONENSIS NAJIM, 1950  
A DERMATITIS-PRODUCING BIRD BLOOD-FLUKE  
(TREMATODA-SCHISTOSOMATIDAE)

(Publication No. 3539)

Abbas Taha Najim, Sc.D.  
University of Michigan, 1952

Non-human blood-flukes, including those of birds, have attracted more attention of investigators since it has been found that the dermatitis commonly known as the "swimmer's itch" is caused by the cercarial stage of most of these blood-flukes. As a part of a thorough natural control, studies on the biology and ecology of the intermediate host as well as studies of the life history of the parasites are of great value.

The life-cycle of Gigantobilharzia huronensis Najim, 1950 has been completed experimentally and detailed studies have been made on each stage of the life-cycle.

The snail Physa gyrina (Say) serves as the intermediate host; the goldfinch (Spinus tristis tristis) and the cardinal (Richmondena cardinalis) serve as the natural definitive hosts. Chicks and canaries were found to be susceptible hosts in the laboratory.

The eggs start hatching in water within about twenty minutes. Cercariae are liberated from the snail as early as twenty-four days. Eggs are found in the feces of the definitive host in thirty-one days after the first exposure to the cercariae.

The adult worms are elongate and filiform; females are longer than males. Oral and ventral suckers are absent in both sexes. Three females measured in length about 16 mm., 18 mm. and 24 mm. A fourth female almost entire measured in length 29 mm. The width of the female anterior to the ootype averages 0.051 mm. Lauer's canal is present and up to seven eggs at a time may be present in the uterus. The genital pore is located shortly posterior to the mouth opening. A young male measured in length about 9.6 mm. The width of the male anterior to the gynaecophoric canal averages 0.051 mm. The gynaecophoric canal is short. Up to 300 + testes are present and the cirrus is spiny.

Specimens of the adults are catalogued as follows: U.S.N.M. Helm. Coll. No. 37334, paratypes

male fragment and female, from chicks.

Eggs are spineless, spherical to very broadly oval, and average 0.093 mm. by 0.088 mm.

The miracidium has a peculiar wide gap between the second and third rows of epidermal plates; its body covering consists of twenty-two epidermal plates arranged in four rows thus: 6:9:4:3. Average body measurements are 0.158 mm. by 0.058 mm.

Specimens of the miracidium are catalogued as follows: U.S.N.M. Helm. Coll. No. 37336, Miracidium.

The mother sporocyst has an elongate, sac-like body. A birth pore is present in the mature mother sporocyst.

The daughter sporocyst is also elongate but unlike the mother sporocyst, its anterior end is covered with spines. A birth pore is present in the mature daughter sporocysts.

The cercaria is an aphygyngeal, furcocercous, brevifurcate, distome with pigmented eyespots. Its body averages 0.240 mm. in length by 0.072 mm. in width. The tail stem averages 0.268 mm. in length by 0.030 mm. in width. The furca averages 0.147 mm. in length by 0.015 mm. in width, and is provided with fin folds. The body and tail are covered with spines. The cercaria has five pairs of penetration glands and an oral gland. The excretory system is usually 2 [(2) + (2 + 1)]. The cercaria attaches to the surface film of the water with body parallel to it and the tail hanging downward at various angles. The cercaria is a dermatitis producer in human skin.

A specimen of the cercaria is catalogued as follows: U.S.N.M. Helm. Coll. No. 37335, Cercaria, from Physa gyrina (Say).

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#### QUANTITATIVE EFFECTS OF DIET, AGE, TEMPERATURE AND HUMIDITY ON THE CUTICLES OF FIVE REPRESENTATIVE SPECIES OF INSECTS

(Publication No. 3198)

Ching-hsi Tsao, Ph.D.  
University of Minnesota, 1951

In recent years research work on insect cuticles has been extensive, especially on the analysis of the chemical components of cuticles; however, information on whether or not the amount of cuticle or its chemical components varies considerably between individuals is lacking. If there is variation between individual insects, the question arises as to whether or not it is a result of environmental differences. In the present paper the amount of cuticle and chitin in five species of insects, and the cuticular chitin per-

centages were determined, as well as their relation to diet, age, temperature and humidity. The insects used are Blatta orientalis, Tribolium confusum, Tenebrio molitor, Galleria mellonella and Phormia regina.

It was found that for the purpose of quantitative estimation of chitin content of cuticles, either the traditional method or the chitosan method can be used satisfactorily. The latter is done by converting chitin into chitosan by the treatment of cuticles or purified chitin with concentrated potassium hydroxide solutions at 160° C. for short period of time; and the former, by treating cuticles with 10% sodium hydroxide solutions at 100° C. for periods of several days. In terms of reproducibility of results, the averages of deviation from the mean of determinations of chitin and chitosan from identical specimens of larval cuticles of Galleria were all less than 3%.

When preparations of chitin and chitosan were made starting, for each, with entire cuticles, the ratio was found to be 100.0 : 78.7; when previously purified chitin was converted to chitosan a ratio of 100.0 : 77.6 was found. The theoretical ratio is 100.00 : 79.32.

In Tenebrio beetles the chitin content of females is higher than that of males. In Blatta, the chitin content of abdominal cuticles of males is higher than that of females; and in either sex the cuticular chitin content of abdominal tergites is lower than that of sternites.

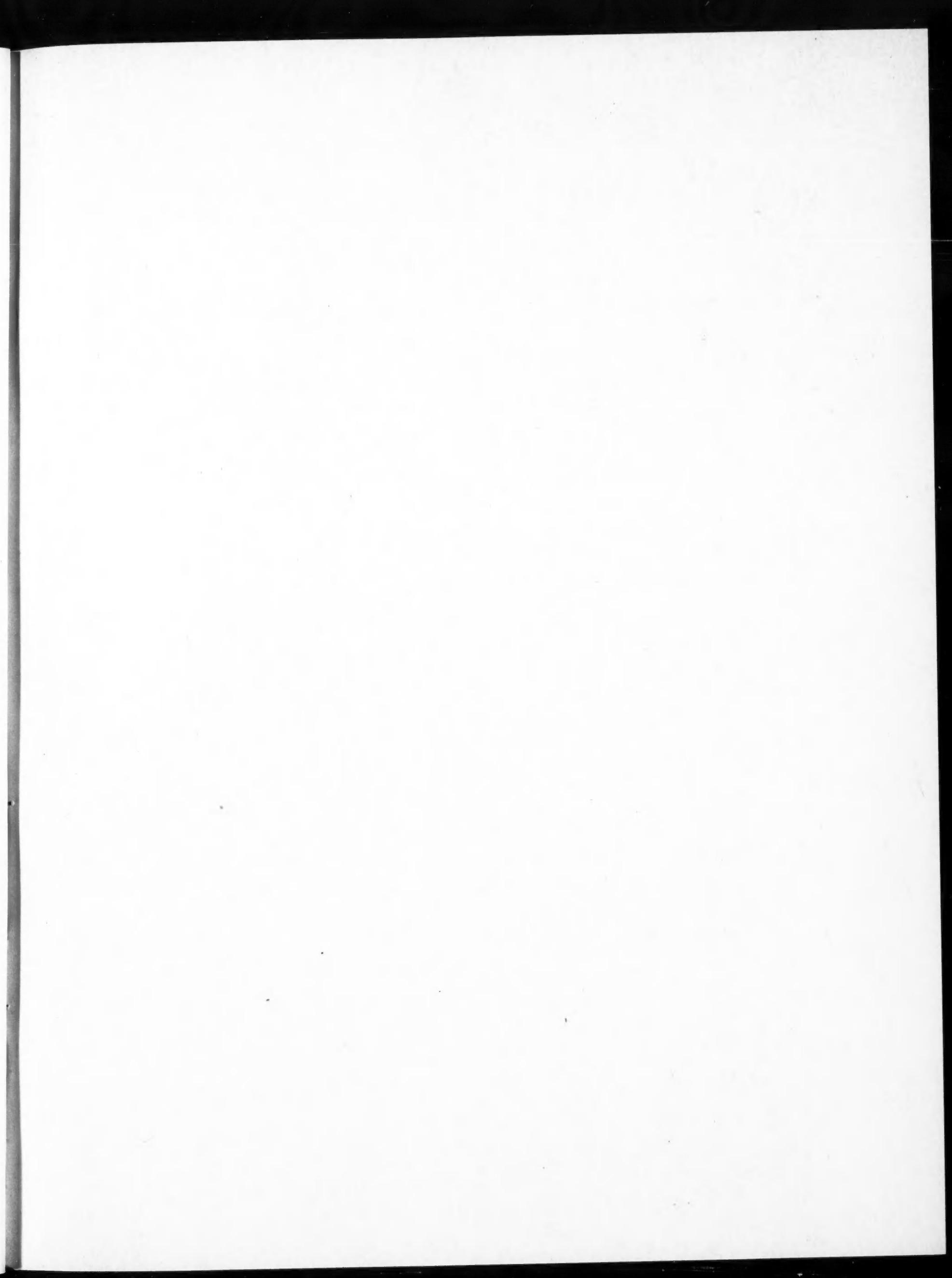
The cuticle or chitin content of insects may or may not vary as a function of the body weight. In Galleria larvae, the percentages of chitin or cuticle decrease with increasing body weight. In Phormia larvae and Blatta adults the percentages of cuticle or chitin in relation to body weight remain constant.

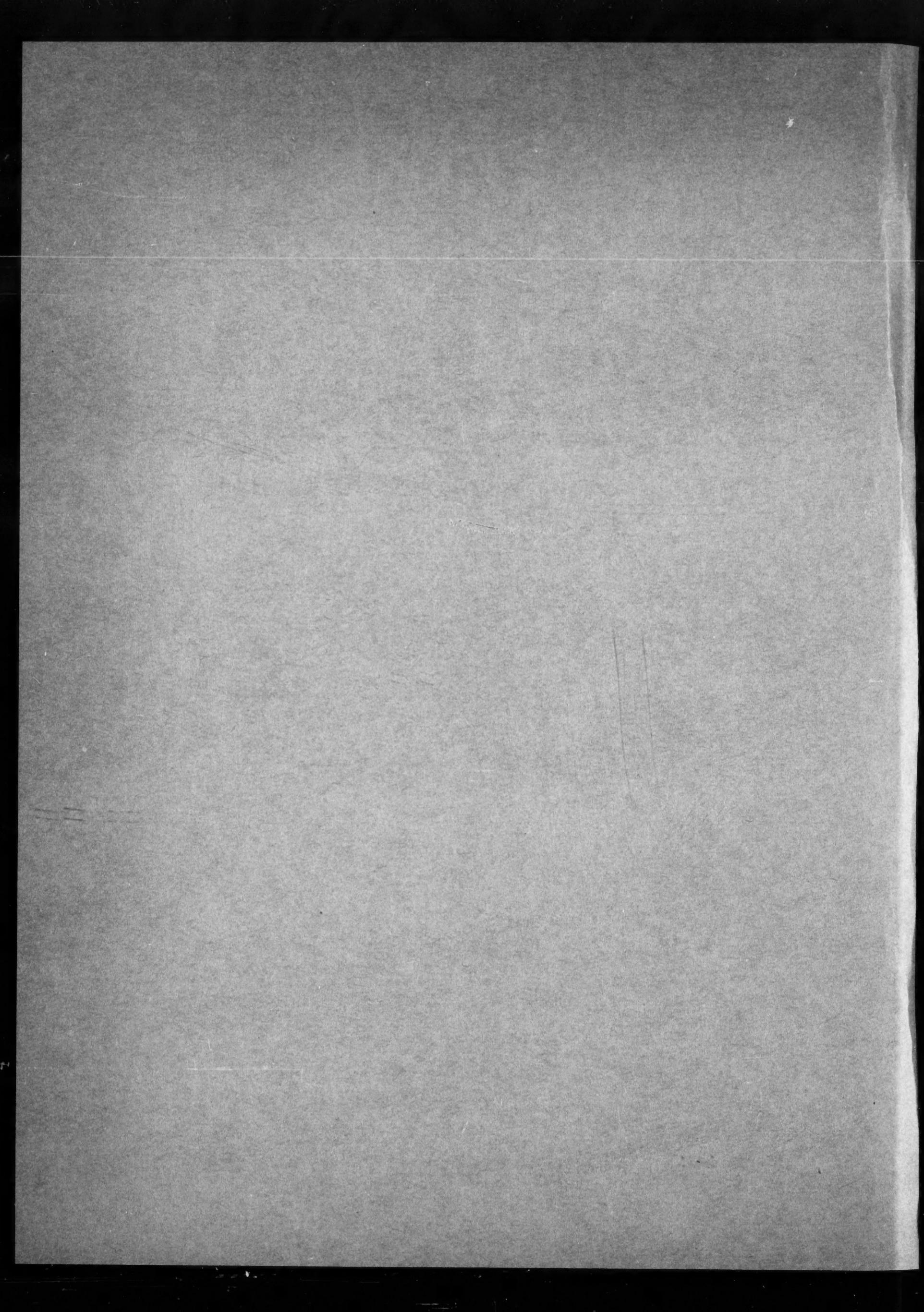
Individual variation of chitin content of dry cuticles within similar stages of a single species shows an average deviation from the mean approximately 8% in Galleria larvae and 5% in Phormia larvae. There is also a similar degree of individual variation in total chitin or cuticle content of the bodies of these two species.

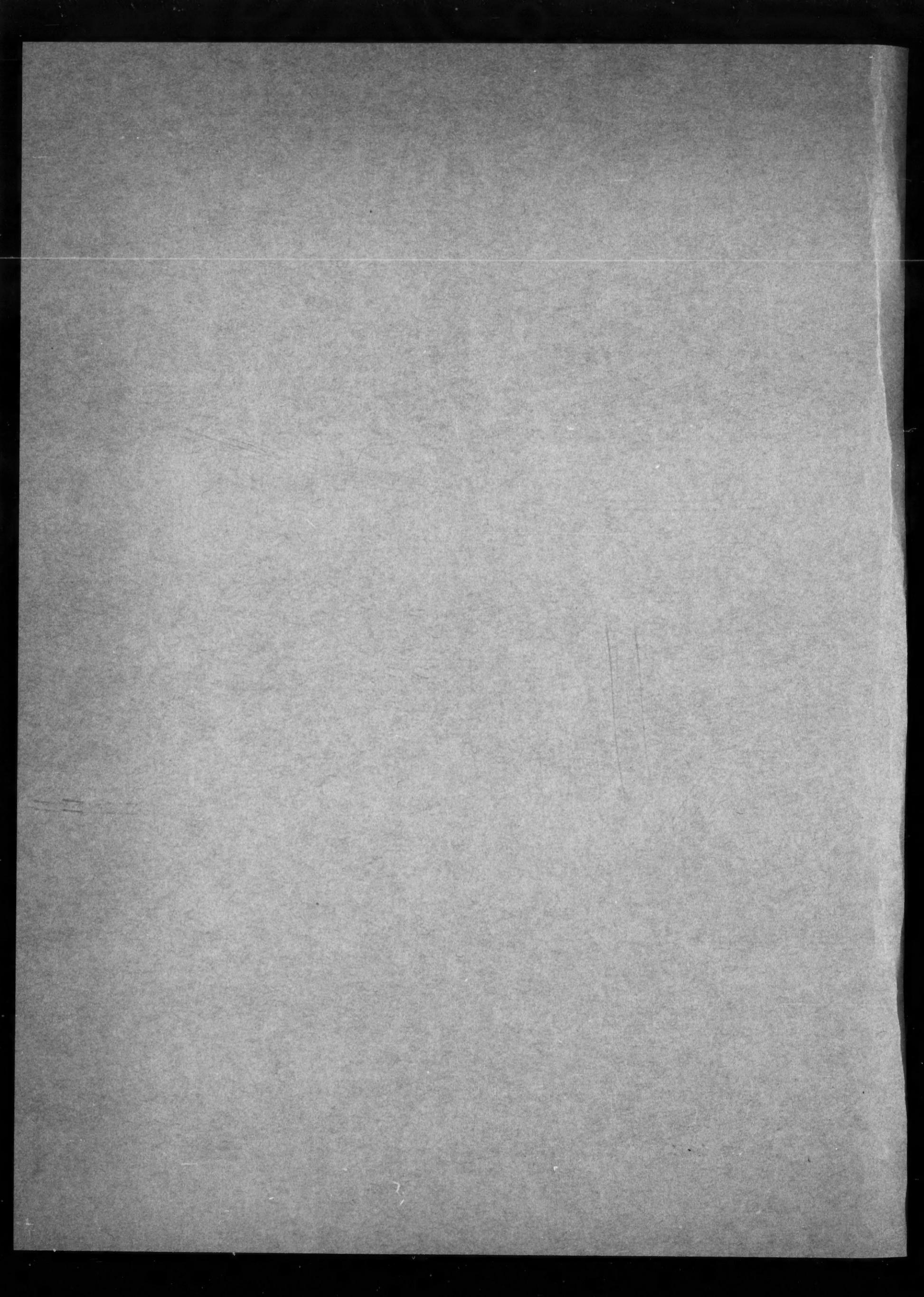
Low temperatures retard the growth rate of Galleria and Phormia. Low carbohydrate diets retard the growth rate of Blatta and Tenebrio, while a high carbohydrate content in the diet prolongs the immature stages of Phormia. However, neither temperature nor diets definitely affect the cuticular content or the percentages of chitin or cuticle in the bodies of the five species of insects.

Variation positively correlated with and so presumably directly due to any of the experimental treatments employed is either absent or of the order of only a few per cent.

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**DISSERTATION ABSTRACTS**

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